ST. JOHNS RIVER BASIN, FLORIDA

INTERIM WATER QUALITY MANAGEMENT PLAN FINDINGS

Special Publication SJ 86-SP2

US Army Corps
of Engineers
Jacksonville District

ST. JOHNS RIVER BASIN, FLORIDA
INTERIM WATER QUALITY MANAGEMENT PLAN FINDINGS

SYLLABUS

This special report was prepared in response to Public Law 98-50 which provided funds for this investigation and directed the Corps of Engineers to prepare an interim water quality management plan for the St. Johns River Basin.

The St. Johns River Basin study area encompasses an approximately 9,200 square mile drainage area within all or parts of 15 counties that comprise most of the east-central and northeastern parts of Florida. The Upper Basin River Valley originates at an approximate elevation of 25 feet above mean sea level and extends some 113 miles northward to river mile point 191 where surface water elevations fluctuate about mean sea level. The downstream 191 miles of the river have been divided for this study into the Middle Basin to river mile point 101 and the Lower Basin to the Atlantic Ocean. Tidal influences extend southward and upstream through much of the Middle Basin, gradually becoming imperceptible. As a result, the St. Johns River upstream of its mouth and into the Middle Basin exists as a shallow, very wide waterway with estuarine characteristics.

The findings of the study are:

1. Technical information is lacking on water quality improvement and environmental enhancement needs and these needs can be more effectively determined upon completion of the needed water quality evaluations described in this report;

2. Information on recreational and other usage of the St. Johns River Waterway System is inadequate, and a review of existing waterway usage and potential demands are needed for water quality management and other purposes;

3. The determination of investigation needs presented in this report provide interim plan findings for obtaining fundamental information upon which a long-range water quality management plan for the basin can be used.

DISCLAIMER

The contents of this report are produced as received from the contractor.

The opinions, findings, and conclusions expressed are not necessarily those of the St. Johns River Water Management District, nor does mention of company names or products constitute endorsement by the St. Johns River Water Management District.

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STUDY AUTHORITY

General

This special report was prepared under authoritv contained in the Energy and Water Development Appropriation Act, 1984 (Public Law 98-50). PL 98-50 provided funds and directed the Corps of Engineers to prepare an interim water quality management plan for the St. Johns River Basin.

House Report No. 98-217

The Energy and Water Development Appropriation Bill, 1984 (HR No. 98-217) provides, "St. Johns River, Fla - The Committee has included $100,000 and directs the Corps of Engineers to prepare an interim water quality management plan for the St. Johns River Basin, Fla. This report is to be prepared at full Federal expense and in cooperation with local interests.".

STUDY SCOPE

This special report includes consideration of the State of Florida's primary interests in establishing an interim water quality plan for the St. Johns River system upon which future development actions within the basin could be evaluated.

DESCRIPTION OF STUDY AREA

The St. Johns River Basin encompasses an approximately 9,200-square-mile drainage area and is considered the largest river system located entirely within the State of Florida (plate 1). The basin is located within all or parts of 15 counties that comprise most of the east-central and northeastern parts of the State. The St. Johns River is unique in several respects. Its southwestern and western headwater areas occur along the drainage divide with streams flowing directly to Lake Okeechobee. The river's valley headwaters occur in a 400-square-mile freshwater marsh in Indian River County. The southern limits have been determined as the Florida Sunshine Parkway, where this roadway crosses the St. Johns River valley at about river mile point 304. From this locality, the river naturally flows northward via a series of water control canals constructed by agricultural interests and natural sheet flow when water levels become high. Flows are almost completely controlled for about 20 river miles under normal and low flow conditions. After passing the last valley barrier, locally known as the Fellsmere Grade, the river water flows via canal and sheet flow about 8 miles before the first discernible channel of the St. Johns River becomes apparent at mile point 275.9. The river then flows via its channel to the vicinity of downtown Jacksonville and then eastward about 25 miles before discharging into the Atlantic Ocean at Mayport (table 1 and plate 2). The approximately 191 miles of the river's main stem located to the north of the bridge crossing of State Road 46 (table 2) is described in this report as the Middle and Lower Basins. This entire segment of the St. Johns River has water surface elevations that fluctuate ahout mean sea level (plate 3). As a result, water surface elevations fluctuate according to the volume of water being discharged, astronomical and storm tides influences affecting the Atlantic Ocean adjacent to the northeast Florida coast, and wind effects.

For this study, the St. Johns River Basin has been divided into three subbasins along the main stem of the river. The Upper St. Johns Basin consists of approximately 113 miles of the river valley from the headwater marshes at an elevation of aoout 25 feet, N.G.V.D., to a roadway bridge crossing (State Road 46) at rlver mlle point 191 with a normal surface water elevation very close to mean sea level. The Middle Basin consists of the essentially tidewater influenced river system between mile point 191 and the river's confluence with the Oklawaha River at river mile point 101. The Lower Basin consists cf the 101-mile tidewater influenced river segment that ultimately dlscharges to the Atlantic Ocean. The Oklawaha River Basin, an approximately 2,750-square-mile subbasin, is the major tributary to the St. Johns River. This fourth major subbasin of the river system has its headwaters at elevations that reach 300 feet above mean sea level along the central highlands of Florida. The lower part of the Oklawaha River has been improved for use as the Cross Florida Barge Canal where water is controlled through two structures that create a body of water known as Lake Ocklawaha (plate 4). Flows are discharged easterly at Rodman Dam along the natural Oklawaha River and at Buckman Lock along a canal constructed to the St. Johns River near Palatka, Florida.

TABLE 1

ST. JOHNS RIVER REFERENCE TABLE
REFERENCE MILEAGE, TRIBUTARIES, AND OTHER BASIN DATA

Waterway Name	Length Miles	Slope: Elevation Ft., MSL		Slope: Average Fall	Discharge Rate (CFS)(1)			Extent of Tidal Influence (Mile Above Mouth)	Mean Tide Range (Feet)	Reference Mileage From Mouth(2)	Reference Mileage From Headwaters
		Source	Mouth	Feet/Mile	Max.	Min.	Mean				
ST. JOHNS RIVER LOWER BASIN											
LOWER BASIN											
Atlantic Ocean		20	0	0.1	61,100	(-)51,040	5,509	110.0	4.9	0	275.9
Haulover Cr.	1.9							1.9	4.5	2.0 L	273.9
Shipyard Cr.	.7	5	0	10.0				.7	3.5	7.8 R	268.1
Old Channel	5.1							5.1	3.4	8.0 L	267.9
Clapboard Cr.	6.7	10	0	1.3				6.7	3.4	8.8 L	267.1
Cowhead Cr.	1.5	28	0	15.6				.4	3.2	9.3 R	266.6
Browns Cr.	3.2							3.2	3.2	10.3 L	265.6
Ginhouse Cr.	3.2	40	0	13.8				.5	3.2	9.5 R	266.4
Jones Cr.	2.8	35	0	15.6				2.8	3.1	9.9 R	266.0
San Carlos Cr.	1.7	8	0	3.5				1.7	3.0	11.5 L	264.4
Newcastle Cr.	1.0	25	0	20.8				.2	2.8	13.0 R	262.9
Dunn Cr.	9.0	0	0	.0				6.1	2.7	13.3 L	262.6
Broward R.	4.0	0	0	.0				4.0	2.6	14.0 L	261.9
Drummond Cr.	2.5	10	0	4.8				1.7	2.5	15.0 L	260.9
Trout R.	18.9	80	0	4.1				10.0	2.3	16.6 L	259.3
Long Branch	1.6	15	0	8.3				.4	2.2	17.7 L	258.2
Deer Cr.	1.0	8	0	8.9				.2	1.9	20.2 L	255.7
Arlington R.	2.2	10	0	5.3				2.1	1.6	21.5 R	254.4
Miller Cr.	.8	20	0	20.0				.8	1.5	22.2 R	253.7
Hogan Cr.	2.5	15	5	4.2				.9	1.4	23.3 R	252.6
McCoys Cr.	2.4	15	0	4.4				1.5	1.3	24.4 L	251.5
Marco Lk.	.4							.4	1.0	26.1 R	249.8
Craig Cr.	1.1	20	0	11.8				.5	1.0	26.4 R	249.5
NNC (3)	1.2							.5	0.9	27.0 R	248.9
Big Fishweir Cr.	1.6	20	0	11.1				.5	0.9	27.0 L	248.8
Ortega River	22.8	40	0	2.5	2,950	0.2	45	9.4	0.9	27.1 L	248.8
New Rose Cr.	.7							.7	0.9	28.9 R	247.0
Christopher Cr.	1.0	20	0	14.3				.8	0.9	29.6 R	246.3
Goodby's Cr.	1.7	5	0	2.9				1.6	0.8	32.2 R	243.7
NNC	.7							.3	0.8	34.0 R	241.9

TABLE 1 (Continued)

Waterway Name	Length Miles	Slope: Elevation Ft., MSL Source	Slope: Elevation Ft., MSL Mouth	Slope: Average Fall Feet/Mile	Discharge Rate (CFS)(1) Max.	Discharge Rate (CFS)(1) Min.	Discharge Rate (CFS)(1) Mean	Extent of Tidal Influence (Mile Above Mouth)	Mean Tide Range (Feet)	Reference Mileage From Mouth(2)	Reference Mileage From Headwaters
Deep Bottom Cr.	1.1	15	0	13.6				.6	0.7	35.1 R	240.8
Johnson Slough	1.1							.4	0.7	36.7 L	239.2
Doctor Lk. & Inl.	6.3							6.3	0.7	37.5 L	238.4
Moccasin Slough	.3							.3	0.7	39.2 L	236.7
Julington Cr.	8.4	15	0	1.8				5.5	0.7	39.6 R	236.3
Peters Br.	1.1	7	0	7.0				.7	0.7	40.5 L	235.4
Cunningham Cr.	1.0	15	0	3.8				1.0	0.7	40.9 R	235.0
Kentucky Br.	1.5	25	0	13.9				.4	0.7	43.8 R	232.1
Black Cr.	42.5	8	0	.6	12,600	4	200	13.2	0.8	44.9 L	231.0
Orange Grove Br.	.2	20	0	12.5				.2	0.8	47.0 R	228.9
Governors Cr.	8.2	100	10	12.1				2.0	0.8	47.3 L	228.6
Kendal Cr.	.2	20	0	8.0				.2	0.8	47.7 R	228.2
Trout Cr.	3.6	5	0	1.4				2.8	0.8	51.5 R	224.4
Six Mile Cr.	4.9	20	0	4.1				4.0	0.8	52.0 R	223.9
Clarkes Cr.	7.1	101	0	13.3				.7	0.9	56.9 R	219.0
Tocoi Cr.	3.5	17	0	4.7				.9	1.0	60.0 R	215.9
Paines Br.	1.3	10	0	8.3				.2	1.0	61.8 R	214.1
Cedar Cr.	3.1	25	0	7.1				1.6	1.0	63.5 L	212.4
UNC (5)	.2							.2	1.0	64.5 R	211.4
Mccullough Cr.	4.9	10	0	3.1				.7	1.0	64.8 R	211.1
Elbow Cr.	.3							.3	1.0	65.1 L	210.8
Moccasin Br.	.6	35	5	4.2				.6	1.1	66.5 R	209.4
Deep Cr.	12.0	25	5	1.9				5.4	1.1	67.2	208.7
Bluff Br.	.9	10	0	11.1				.9	1.1	67.3 L	208.6
Mason Br.	3.3							.8	1.1	68.7 L	207.2
Dog Br.	1.3	12	5	3.9				.2	1.1	71.5 R	204.4
UNC	1.1							.4	1.2	71.8 R	204.1
Fish Cr.	1.5	10	5	3.3				.4	1.2	72.5 L	203.4
Rice Cr.	7.9	30	5	1.6	6,480	(-)2,200	345	4.0	1.2	75.3 L	200.6
Cow Cr.	1.5	10	5	3.3				.5	1.2	76.7 R	199.2
UNC	.6	1						.6	1.2	77.1 L	198.8
UNC	.5							.5	1.2	80.6 L	195.3
Mill Br.	4.5	15	5	5.0				.2	1.2	81.4 R	194.5
Bray Cr.	.5							.5	1.1	82.9 R	193.0
Dunns Cr.	8.6	10	5	.6				8.6	1.1	86.4 R	189.5

TABLE 1 (Continued)

Waterway Name	Length Miles	Slope: Elevation Ft., MSL Source	Slope: Elevation Ft., MSL Mouth	Slope: Average Fall Feet/Mile	Discharge Rate (CFS)(1) Max.	Discharge Rate (CFS)(1) Min.	Discharge Rate (CFS)(1) Mean	Extent of Tidal Influence (Mile Above Mouth)	Mean Tide Range (Feet)	Reference Mileage From Mouth(2)	Reference Mileage From Headwaters
DUNNS CREEK										Reference Mileage From Mouth of St. Johns River	Reference Mileage From Mouth of Dunns Creek
Crescent Lk.	13.8			.2				13.8		95.0	8.6
Haw Cr.	9.9	9	8	.2						108.8	22.4
Blk. Pt. Swamp	3.3	9	8							118.7	32.3
ST. JOHNS RIVER											
Polly Cr.	1.3							1.3	1.1	86.5 R	189.4
Murphy Cr.	5.0							5.0	1.0	89.5 L	186.4
Barrentine Cr.	1.6							1.6	1.0	91.1	184.8
Trout Cr.	1.6							1.6	0.9	92.1 R	183.8
Cross Fl. Barge Canal	6.6				171	0	27	1.6	.9	92.8	183.1
Cross Cr.	.9									123.3	152.6
Camp Br.	4.9	20	5	1.6				2.0	0.8	94.7 L	181.2
UNC	.8							.2	0.8	95.8 R	180.1
Acosta Cr.	3.8							.1	0.7	97.7 R	178.2
Oklawaha River	71.3	58	5	0.7	9,560	0	1,900	11.0	0.4	100.8 L	175.1

TABLE 1 (Continued)

Waterway Name	Length Miles	Slope: Elevation Ft., MSL Source	Slope: Elevation Ft., MSL Mouth	Slope: Average Fall Feet/Mile	Discharge Rate (CFS)(1) Max.	Discharge Rate (CFS)(1) Min.	Discharge Rate (CFS)(1) Mean	Extent of Tidal Influence (Mile Above Mouth)	Mean Tide Range (Feet)	Reference Mileage From Mouth(2)	Reference Mileage From Headwaters

OKLAWAHA RIVER

Waterway Name	Length Miles	Source	Mouth	Average Fall Feet/Mile	Max.	Min.	Mean	Extent of Tidal Influence	Mean Tide Range	Reference Mileage From Mouth of St. Johns River	Reference Mileage From Mouth Oklawaha River
Lk. Griffin	7.5									172.1	71.3
Haines Cr.	5.8	62	59	.5	1,350	2	288			179.6	78.8
Lk. Eustis	2.6									185.4	84.6
Dead River	1.1									188.0	87.2
Lk. Harris	7.0									189.1	88.3
Palatlakaha Rv.	30.5	97	63	1.2	486	0	5			196.1	95.3
Lk. Emma	.7									210.2	109.4
Lk. Lucy	1.1									210.9	110.1
Cherry Lk.	.8									216.0	115.2
Lk. Minneola	1.5									219.2	118.4
Lk. Hiawatha	.4									220.7	119.9
Lk. Palatlakaha	.7									221.8	121.0
Lk. Minnehaha	2.4									222.5	121.7
Lk. Susan	.9									224.9	124.1
Lk. Louisa	3.1									226.6	125.8
Big Cr.	3.0	115	100	4.9	691	0	36			229.7	128.9

ST. JOHNS RIVER MIDDLE BASIN

Waterway Name	Length Miles	Source	Mouth	Average Fall Feet/Mile	Max.	Min.	Mean	Extent of Tidal Influence (Mile Above Mouth)	Mean Tide Range (Feet)	Reference Mileage From Mouth(2)	Reference Mileage From Headwaters
MIDDLE BASIN										101.0	174.9
Bear Cr.	6.4	24	8	6.7					0.4	101.0 L	174.9
Little L. George	2.0							2.0	0.4	101.2	174.7
Mud Cr.	.4							0.4	0.3	101.6 R	174.3
Beecher Run	1.5								0.2	104.9 R	171.0
UNC	1.1								0.1	108.0 L	167.9
L. George	12.1									110.1	165.8

TABLE 1 (Continued)

Waterway Name	Length Miles	Slope: Elevation Ft., MSL Source	Slope: Elevation Ft., MSL Mouth	Slope: Average Fall Feet/Mile	Discharge Rate (CFS)(1) Max.	Discharge Rate (CFS)(1) Min.	Discharge Rate (CFS)(1) Mean	Extent of Tidal Influence (Mile Above Mouth)	Mean Tide Range (Feet)	Reference Mileage From Mouth(2)	Reference Mileage From Headwaters
Salt Springs Run	4.3	15	13	7						112.4 L	163.5
Price Cr.	1.8									118.0 R	157.9
Silver Glenn Springs Run	.7									118.8 L	157.1
Little Juniper Cr.	1.5									121.6 L	154.3
Juniper Cr.	9.7									122.1 L	153.8
Blue Cr.	3.7									122.8 L	153.1
Hitchens Cr.	2.9									122.9 R	153.0
Payne Cr.	1.1									123.4 R	152.5
Axie Cr.	.8									123.5 R	152.4
Morrison Cr.	1.2									125.2 R	150.7
NNC	1.5									129.0	146.9
L. Dexter	.9									130.9	145.0

LAKE DEXTER

Waterway Name	Length Miles	Reference Mileage From Mouth of St. Johns River	Reference Mileage From Lake Dexter
Lk. Woodruff	3.0	135.8	4.9
Norris Dead Rv.	6.2	138.8	7.9

ST. JOHNS RIVER

Waterway Name	Length Miles	Slope: Elevation Ft., MSL Source	Slope: Elevation Ft., MSL Mouth	Slope: Average Fall Feet/Mile	Reference Mileage From Mouth(2)	Reference Mileage From Headwaters
Stagger Mud L.	1.8				132.0 L	143.9
Alexander Springs Circle	11.4	30	1	1.5	133.7 L	142.2
UNC	.7				134.1 L	141.8
Cross Cr.	.4				135.1 R	140.8
Get Out Cr.	2.2				136.7 L	139.2
Horseshoe Mud L.	.5				138.0 L	137.9
Twin Lakes (s)	.8				138.7 R	137.2

TABLE 1 (Continued)

Waterway Name	Length Miles	Slope: Elevation Ft., MSL Source	Slope: Elevation Ft., MSL Mouth	Slope: Average Fall Feet/Mile	Discharge Rate (CFS)(1) Max.	Discharge Rate (CFS)(1) Min.	Discharge Rate (CFS)(1) Mean	Extent of Tidal Influence (Mile Above Mouth)	Mean Tide Range (Feet)	Reference Mileage From Mouth(2)	Reference Mileage From Headwaters
ST. JOHNS RIVER											
St. Francis Dead River	1.6									141.0 L	134.9
Honey Cr.	1.6									141.7 R	134.2
Highland Pk Run	.9									143.1 R	132.8
Dean Dead R.	.5									144.5 R	131.4
Mud L.	.8									145.3 L	130.6
Botts Cr.	1.0									145.8 L	130.1
Huntoon Dead R.	5.4									147.5 L	128.4
L. Beresford	2.9									148.2 R	127.7
Blue Spgs Run	.4				214	63	162			150.9 R	125.0
UNC	1.2									154.5 L	121.4
Wekiva Rv.	15.4	15	2	.9	2,060	105	289			156.8 L	119.1
L. Monroe	5.8									162.3	113.6
Bethel Cr.	1.4									167.2 R	108.7
Monroe Canal	1.0									167.8 L	108.1
Woodruff Cr.	1.3									167.9 L	108.0
L. Jessup	9.9									174.2 L	101.7
LAKE JESSUP										Reference Mileage From Mouth of St. Johns River	Reference Mileage From Lake Jessup
Solider Cr.	4.9	40	3	6.9	416	0.2	12			184.1	9.9
ST. JOHNS RIVER											
Deep Cr.	11.2	7	13	.4						186.6 R	89.3
L. Harney	4.4									187.4	88.5

TABLE 1 (Continued)

Waterway Name	Length Miles	Slope: Elevation Ft., MSL Source	Slope: Elevation Ft., MSL Mouth	Slope: Average Fall Feet/Mile	Discharge Rate (CFS)(1) Max.	Discharge Rate (CFS)(1) Min.	Discharge Rate (CFS)(1) Mean	Extent of Tidal Influence (Mile Above Mouth)	Mean Tide Range (Feet)	Reference Mileage From Mouth(2)	Reference Mileage From Headwaters
ST. JOHNS RIVER UPPER BASIN											
UPPER BASIN										191.0	84.9
Econolochatchee R.	42.1	68	5	1.8	11,000	7	273			194.4 L	81.5
Puzzle Lk.	2.8									195.4	80.5
Buscombe Cr.	5.0	48	3	9.2						201.5 L	74.4
Christmas Cr.	5.1	59	3	8.4						202.8 L	73.1
Ruth L.	1.0									205.7 R	70.2
Clark L.	1.3									206.6 R	69.3
CLARK LAKE										Reference Mileage From Mouth of St. Johns River	Reference Mileage From Clark Lake
NNC	.2									207.9	1.3
Loughman Lk.	1.7									208.1	1.5
Shad Cr.	1.2									209.8	3.2
Salt Lk.	1.4									211.0	4.4
ST. JOHNS RIVER											
UNC	3.9									207.9 L	68.0
UNC	3.6									208.3 R	67.6
Jim Cr.	.8									218.4 L	57.5
Taylor Cr.	11.7	25	12	2.2						234.9 L	41.0
L. Poinsett	4.9									236.2	39.7
Rockledge Cr.	2.2									239.8 R	36.1
L. Winder	2.8									246.0	29.9
L. Washington	4.1									257.9	18.0
Sawgrass L.	1.2									265.3	10.6
Little Sawgrass L.	.4									266.7	9.2
L. Hellen Blazes	1.8									269.7	6.2
End of St. Johns Channel	275.9									275.9	0

(1) Furtherest downstream station, negative flows are upstream.
(2) Tributary to Left or Right bank (looking downstream) as indicated.
(3) UNC or NNC indicates unnamed creek.

Source: U.S. Army Corps of Engineers

TABLE 2

BRIDGES CROSSING THE ST. JOHNS RIVER

Miles Above Mouth	Bridge and Location - Owner	Clearances Type[1]	Horz.[2]	Vert.[3]	Permit Date	Completion Date
2.9	Blount Island, Fla. - Jax Port Authority	F	19	8	7/67	6/8
3.0	Blount Island, Fla. - Jax Port Authority	F	18	5	11/68	6/67*
21.4	Mathews Bridge, Jacksonville, Fla., Terminal Channel U.S. 1 and 90 - Florida	F	705	152	1/50	3/53
21.4	Arlington Bridge, Jacksonville, Fla., Arlington Cut - Florida	F	376	86	1/50	3/53
22.1	Hart Bridge, Jacksonville, Fla., Jacksonville Expressway Authority	F	960	141	12/62	11/67
24.7	Main Street, Jacksonville, Fla., U. S. 17 - Florida	VL	350	135	10/65	8/67
24.9	Acosta Bridge, Jacksonville, Fla. S.R. 13 - Florida	VL	174	164	12/16	7/21
24.9	Jacksonville, Fla. F.E.C.R.R.	B	195	-	9/23	5/26
25.4	Fuller Warren, Jacksonville, Fla., 1-95 - Florida	B	173	-	1/50	5/54
34.5	Buckman Bridge (Twin), I-295 - Jacksonville Expressway Authority	F	150	65	9/64	5/70
???	Shands Bridge, Green Cove Springs, Fla. - S.R. 16 - Florida	F	91	45	5/59	11/61
83.1	Palatka, Fla., U.S. 17 - Florida	F		65	2/74	2/81
94.5	Buffalo Bluff - S.C.L.R.R.	B	90	-	2/60	2/62
126.0	Astor, Fla., S.R. 40 - Florida	SW	90	-	8/25	10/26
146.0	Crows Bluff, Fla., S.R. 44 - Florida	B	90	-	3/54	11/55
160.9	Sanford, Fla., - S.C.L.R.R.	B	91	-	4/60	3/61
161.0	Sanford, Fla., U.S. 17 - Florida	SW	90	-	4/32	5/34
161.1	Sanford, Fla., I-4 - U.S. 92 - Florida	F	90	45	7/57	3/61
169.6	Osteen, Fla., S.R. 415 - Florida	F	56	25	-/71	5/77
191.0	Lake Harney, Fla., S.R. 46 - Florida	F	51	26	11/58	11/59
201.0	Christmas, Fla., S.R. 50 - Florida	F	32	12	2/67	11/67
201.0	Christmas, Fla., East Channel, S.R. 50 - Florida	F	23	9	8/32	5/33
201.0	Christmas, Fla., S.R. 50 - Florida	F	32	12	9/68	3/72
212.0	Cocoa, FLa., S.R. 520 - Florida	F	23	2	9/51	3/55
232.0	Melbourne, Fla., U.S. 192 - Florida	F	39	6	9/64	3/67

* Temporary bridge maintained as permanent.
1 Type: F = Fixed, VL = Vertical Lift, B = Bascule, SW = Swing
2 Horizontal clearance represents channel width
3 Vertical clearance is inreference to mean high water
Vertical clearance for a bascula bride is unlimted

___: U.S. Coast Guard, Bridges Over Navigable Waters of the United States, Part 1, Atlantic Coast, CG 425-1, U.S. Department of Transportation, 1973.

PROBLEMS, NEEDS, AND OPPORTUNITIES

Introduction

This section describes study area problems and needs within the context of Corps of Engineers responsibilities but with appropriate consideration given to the major water quality management concerns of the State of Florida and its Congressional representatives. The State of Florida has taken a leading role in the Nation with respect to recognition of the need to protect the quality of the State's waters through comphrensive planning efforts. Throughout the process of this investigation, this primary requisite of water resources planning in the State of Florida was repeatedly expressed by State agency representatives. Accordingly, efforts were undertaken in this report to present Federal water resource responsibilities in context with the primary State and local concern for a need to establish ambient water quality conditions within the St. Johns River system.

Within the St. Johns River Basin, the problems of assuring adequate water supplies of acceptable qualities are compounded by the orientation and hydrodynamic character of the river and by Florida's climatic conditions. The St. Johns River originates in a large marshland area with prolific vegetative growth due to near subtropical climatic conditions that approach year-around growing conditions. This pattern is periodically interrupted by occasional short, severe cold spells; prolonged droughts; and occasional severe floods which prematurely terminate natural growth cycles of affected vegetation. These events can be expected to result in vegetation die-off and large litter falls, increases in nutrients from the decomposition of litter, and increases of nutrients in runoff and canal or stream discharges to the St. Johns River. Analyses of seasonal and more random types of water discharges; vegetation related nutrient contributions in runoff from river flood plain related natural areas; and corresponding contributions from agricultural, forestry, and urban lands have not been undertaken within the basin.

Even the seasonal wet summer/fall and dry winter/spring conditions characteristic of Florida contribute to the cycle of termination of vegetation growth, aerobic decomposition of litter on land and in well oxygenated water areas, and facultative or anaerobic decomposition in poorly oxygenated water bodies and permanently inundated swamps and marshes where acid forming and methane bacteria digest the organic matter. With summer rainfalls and where water velocities are sufficient, materials in various states of decomposition are transported by runoff to canals, streams, and the St. Johns River. Water sampling programs to determine the general nature and relative stream contributions from these normal processes under existing seasonal conditions remain to be undertaken within the St. Johns River Basin.

In general, between 10 and 30 percent of metropolitan urban area lands typically are devoted to structures, streets, and other impervious areas. Much of all urban areas is vegetated, and provides litter contributions to the environment, part of which eventually becomes nutrient loadings in surface water runoff. Prior to development, natural vegetation provided nutrients in surface water runoff from land areas in a similar manner. Correspondingly, agricultural areas' unique nutrient contributions to the quality of nearby watercourses result from nutrients imported, unharvested crops or animal products, and subsequent runoff. The differences between such runoff as compared to nutrients in runoff from the former natural vegetation in agricultural areas are unknown. Because analyses of these relative nutrient contribution differences have not been accomplished within the basin and the ambient water quality of the St. Johns River has not yet been established, the impacts of various types of development upon environmental conditions within the river system are generally acknowledged but remain technically undetermined.

FEDERAL RESPONSIBILITIES

Flood Control

Flood control problems were identified in the Upper St. Johns River Basin in the initial Survey Review for the Central and Southern Florida Project in 1947. A project was authorized in 1948 (Public Law 858, 80th Cong., 2d. sess.) to provide flood control for the rich agricultural lands to the south of Lake Okeechobee and to the highly developed urban areas along the lower east coast of the State. The remaining works, including flood control protection in the Upper St. Johns River Basin, were authorized in 1954 (Public Law 780, 83d. Cong., 2d sess.). Flood control plans authorized under this latter authority have recently been completed and are now undergoing review (see Ongoing Studies Section, General Design Memorandum (GDM) Central and and Southern Florida Project, Part 3, Supplement 2, Addendum 3). This project addresses all known flood control problems in the Upper St. Johns River Basin.

No other flood control problems were identified in the remainder of the St. Johns River Basin. The State of Florida has expressed an interest in attempting to resolve flooding problems, to the degree possible, through nonstructural alternatives. Accordingly, all State of Florida agencies, including the St. Johns River Water Management District, East Central Florida Regional Planning Council, North Central Florida Regional Planning Council, and the Northeast Florida Regional Planning Council currently encourage development practices that stress nonstructural flood damage reduction measures. Towards this end, 7 counties and 27 muncipalities within the basin have volunteered to participate in the National Flood Insurance Program (see Other Federal Studies section). These participating communities include most local government jurisdictions that could be subject to flooding along the St. Johns River. Remaining areas of the river system that may be subject to flooding problems can be accommodated under other existing Federal authorities.

Water Supply

Review of Federal authority to consider provisions of surface water supplies from existing projects was undertaken. Some agricultural water supply concerns are being addressed in the ongoing Upper St. Johns River Basin Part of the Central and Southern Project for Flood Control and Other Purposes. A major need for improved potable water supplies for the more than 90,000 people of southern Brevard County who now must depend upon surface water from Lake Washington on the St. Johns River has been previously recognized. Regarding this problem area, the State of Florida considers the natural value of swamps along Jane Green Creek superior and has determined that the use of this valley for surface water storage for subsequent release to augment water in Lake Washington during drought conditions to be unacceptable. Accordingly, while the Jane Green Creek watershed waters will be controlled under the Upper St. Johns River Basin Project for flood control purposes, permanent water storage for water supply purposes is not being considered as a project purpose. No other potential water supply problem within the context of existing Federal responsibilities was identified during this investigation.

Water Quality Improvement

This report's STUDY CONSTRAINTS section provides information on Corps of Engineers responsibilities for water quality improvement. The PRIOR AND ONGOING STUDIES section of this report identifies Federal project investigations conducted in the St. Johns River Basin. A continuing Federal responsibility exists to assure that existing projects do not degrade the water quality of the basin. It is also a Federal responsibility to modify projects to assure the protection of the river's water quality and to mitigate for damages in those cases where appropriate water quality cannot be maintained. The State of Florida considers that the current information available on the ambient water quality of the St. Johns River is not adequate for these purposes and for their water management purposes.

The existing works of the ongoing project in the Upper Basin discharges water of varying quality through Lake Washington and into the river-run lakes of the Middle Basin. Lake Harney, the uppermost lake of the Middle Basin, is also the locality of the upper limits of the Federal waterway project between Jacksonville and Sanford. The Cross Florida Barge Canal discharges water at two points along the St. Johns River near the uppermost parts of the Lower Basin. The Jacksonville Harbor project encompasses the entire 25 miles of the Lower St. Johns River from downtown Jacksonville to the Atlantic Ocean. The Intracoastal Waterway transects the St. Johns River's Lower Basin estuaries from north to south and the St. Johns River at a point about 5 miles from the ocean.

The existing impacts of the above Federal works and their uses upon the ambient quality of the St. Johns River is largely unknown. Without improved information on the ambient water quality of the river, possible ongoing and future impacts of project related activities would remain difficult to evaluate. Establishment of ambient water quality data, as part of an environmental assessment of existing Federal project works that may be impacting the St. Johns River, would be necessary to provide improved technical information upon which to base modifications of existing projects and the design of new projects.

Recreation

The ongoing project in the Upper St. Johns River Basin has included a recreation element, and no further consideration of this need for the Upper Basin has been considered in this report. The City of Jacksonville, in material provided for this report, expressed a major concern for the inadequacy of public access to the St. Johns River for the rapidly expanding passive and recreational needs of the Metropolitan area.

The St. Johns River and the Federal waterways throughout the Middle and Lower Basins are known to be widely used for surface water recreational activities. No detailed information on these uses or potential needs were available for this report.

A generalized evaluation of outdoor recreation needs in Florida has been prepared by the Division of Recreation and Parks, State of Florida Department of Natural Resources. The St. Johns River flows through the east Florida and northeast Florida regions (Regions IV and VI) described in the State's 1981 report. The major resources facility needs identified for these two regions for 1990 were: freshwater fishing (nonboat), 18,280 lineal feet; freshwater swimming (nonpool), 72,860 lineal feet; nature study, 2 miles; and visiting archeological/historical sites, 52 sites. The State report did not identify any future needs for expanded boat launching facilities within these two regions.

While the State outdoor recreation needs report provides broad, regional guidance on recreational facilities and needs, the general scope of the report precludes identification of subregional dislocalities between available recreational facilities and needs. Moreover, the State report uses generalized assumptions on the quality of available recreational facilities that may be incongruent with local recreational needs. As a result, the State report lacks the refinement necessary for comparing recreational facility availability with existing and projected demands along the St. Johns River.

No other funded Federal authorization exists to investigate the recreation needs of the St. Johns River Basin. The actual need is currently unknown, and further evaluation of recreational usage of the waterways in the Middle and Lower Basins appears warranted.

Environmental Enhancement

Environmental enhancement, including preservation and/or restoration of flood plain wetlands in the basin, is a major State of Florida concern. This concern has been addressed in the ongoing project for the Upper Basin. Wetlands exist along most of the course of the St. Johns River and are major contributors to the existing quality of water within the river. Plate 5, which identifies generalized groundwater discharge areas with seepage to surface waters, also identifies the predominant areas of riverine wetlands along the St. Johns River. Due to Florida's physiography, the flatness of adjacent land terrain in extended areas results in a typical gradual gradation from dry land, through wetland conditions, and to the St. Johns River channel. With heavy and extended rainfall periods, the river flow expands into wetlands, and flooded areas often extend well into the Florida flatwoods areas. Correspondingly, when prolonged droughts occur, the flatwoods and many wetlands can become drained, and fresh surface water flow to the St. Johns River can become reduced significantly or cease entirely. These natural processes affect the contributions of wetlands flows to the St. Johns River and the quality of water being discharged from wetlands. The ongoing and fundamental geochemical processes associated with these natural conditions are not well understood in the St. Johns River Basin. Without improved knowledge, the determination of appropriate means of wetland protection cannot be technically determined, and the technically determined benefits attributable to wetlands remain largely conjectural. Ongoing and future Federal investigations in the St. Johns River Basin and elsewhere would be greatly benefited by further investigation of wetlands' contributions to river flow and water quality in the basin.

WATER QUALITY/ENVIRONMENTAL EVALUATION NEEDS

Introduction

Technical information on water quality/area environmental conditions have increased markedly during the past decade. For many years, water quality criteria have been used as bases for determining the suitability of water for particular uses. These criteria gradually have been incorporated into standards or official agency guidance for determining water conditions. However, scientists and technical specialists have been aware of the many factors that affect the quality of natural waters, and as general awareness of the environment has matured, the ability to consider more realistic measures to evaluate the quality of natural waters has become possible.

The term "water quality," has many different meanings. The term now has status much like the terms, "conservation of resources" and "environmental quality." All of these terms have been widely used, and each is used differently to meet semantic requirements of particular situations. Accordingly, the terms, "water quality management" and "water quality improvement," have little meaning without more complete definition.

Throughout this investigation, the St. Johns River Water Management District noted the need to establish ambient water quality conditions along the St. Johns River. Ambient water quality can be defined as, "the undisturbed or natural water quality conditions of a localized area unaffected by outside and unnatural influences." Current environmental concepts consider that man's activities are representative of outside and unnatural influences, and all of the earth's normal geochemical processes would be natural.

Essentially, all of the surface waters in the St. Johns River Basin, with the possible exception of some flowing springs, can be expected to have been impacted in some manner by man's activities. At the present time, the term, "ambient water quality," is used imprecisely, and with varying meanings applied to the term, communications regarding the subject are difficult. Apparently, no effort has yet been undertaken in the St. Johns River Basin to establish a clear technical basis for classifying water conditions as ambient based upon the natural and normal chemical and biological compositions that may be expected in localized areas.

The Geochemical Basis of Ambient Water Quality

The Science of Geochemistry provides descriptions of the natural geochemical processes (normally consisting of biogeochemical interactions) that operate to determine the ambient water quality characteristics of various common localities within the St. Johns River Basin. Geochemistry (the science of the earth's physical-chemical composition and processes) describes the fundamental and continually ongoing chemical processes operating upon or within: (1) the earth's mantle or rock formations and soils (lithosphere); (2) the plants, animals, and microorganisms (biosphere); (3) the fresh and salt waters of the earth's water blanket (hydrosphere); and (4) the gaseous envelope surrounding the earth (atmosphere). Within and among these four general parts of the environment, inorganic and organic chemical interactions are continually occurring. Water functions as a solvent medium for these interactions and as a transport mechanism for carrying the interacting chemical constituents towards a lower elevation or the sea. Correspondingly, all ongoing geochemical processes in the basin affect and determine the ambient water quality of the St. Johns River. This ambient water quality will be highly variable over time and will change following effects of weather, seasons, other natural condition changes, and man's activities.

Currently, raw water quality data are normally collected from within the water column of a water body and interpreted without clear definition of the biogeochemical interactions occurring at the time the water was sampled. As a result, the casual factors for water quality conditions identified along the St. Johns River can be easily misinterpreted. A determined water quality condition may or may not conform to Florida receiving water quality standards, but the reasons for the noted water quality conditions presently must be based upon largely conjectural technical assumptions. Until the normal ranges of parameter constituents of water at various elevations within the water column can be reasonably established, efforts to base ambient water quality conditions solely upon water column data, would be of limited productivity.

Much of the available water column data for the St. Johns River were collected for specific purposes of the collecting agencies and are often very incomplete. Review of available reports mentioning water quality conditions and current data collection programs dealing with the river also indicates that little emphasis is normally given to bottom sediment analyses. Water column data is useful for tracing immediate or short-term factors that may be influencing local water quality. However, water column biogeochemical characteristics are known to change hour-by-hour and day-by-day at any given locality within a larger body of water. Part of this variation occurs as a result of variations in surface water discharges from a river's tributary watersheds and drainage areas. Part of the variation also occurs as a result of groundwater seepage that mixes with surface water in watershed discharge areas. Some of the materials carried by these waters in suspension and solution settle or precipitate out as a result of interactions with the receiving waters. As the resultant particulates increase in size and/or as streamflow becomes reduced, these materials gradually filter downward to form the river's bottom sediments. Analysis of these sediments provides strong corollary and relatively stable data useful for determining long-term watershed contributions to the St. Johns River's water quality.

River bottom sediments also serve as a major source of nutrients, metals, and other water quality constituents to the adjacent water column. Continual biogeochemical interaction is normally occurring near the bottom of the water column and at the interface of water with bottom sediments. Due to this interaction, the chemical composition of the water column is continually altered under differing inflow conditions, temperatures, availability of dissolved oxygen, and pH. As a result of ongoing biogeochemical interactions, various chemical constituents are continually being taken up or are being given off by the bottom sediments. While these normal biogeochemical interactions are generally understood, the application of this knowledge to an understanding of ambient water quality conditions in the St. Johns River remains to be developed.

Water Quality Management Concepts

Current water quality management concepts within government agencies have been largely patterned after Federal Water Pollution Control legislation enacted since 1948. These legislative acts have necessarily focused upon the impacts of man's activities upon the Nation's resource base and the need to protect the public and the natural environment. Pollution has generally been thought of as man's contamination of land and water. As a result, recent Federal legislation has been heavily oriented toward the development of effluent limiting standards and regulations regarding human activities.

A second approach to water quality management focuses upon receiving water quality criteria for various types of water uses and the development of standards and regulations that should be maintained in receiving water bodies. While both effluent limiting and receiving water quality standards are important for the protection of the St. Johns River water quality, the early development of water quality management tools for improving knowledge of the St. Johns River within the context of Florida's receiving water quality standards appears to be needed. However, these standards represent environmentally or epidemiologically acceptable water quality conditions. Certain of these standards may not be consistently achievable for certain bodies of water or within localities of a water body due to biogeochemical factors that determine ambient or natural water quality conditions.

The following definition of pollution from the Florida Rules of the Department of Environmental Regulation, "Florida Water Quality Standards" (included in this report as appendix B), Chapter 17-3, Part II, Definitions, (17) provides useful guidance for this initial planning step:

> "Pollution" shall mean the presence in the out-door atmosphere or waters of the state of any substances, contaminants, noise, or man-made or man-induced alteration of the chemical, physical, biological or radiological integrity of air or water in quantities or levels which are or may be potentially harmful or injurous to human health or welfare, animal or plant life, or property, including outdoor recreation."

Water Quality Criteria and Standards

Florida's receiving water quality standards represent a long evolvement of technical information on the water quality needs for public health and welfare purposes and environmental (essentially fish and wildlife) protection. For water quality planning purposes, it is useful to review some of the bases for these standards in order to understand factors against which the St. Johns River natural or ambient water quality currently are measured.

Some of Florida's current standards emerged from Water Quality Criteria established by the Federal Water Pollution Control Administration (the predecessor of the U.S. Environmental Protection Agency) in the 1960's. From the section of the April 1968 Report of the National Technical Advisory Committee to the Secretary of the Interior dealing with Fish, other Aquatic Life, and Wildlife, the following guidance is appropriate for consideration in a program for water quality management planning in the St. Johns River Basin:

> In determining water quality requirements for aquatic life and wildlife, it is essential to recognize that there are not only acute and chronic toxic levels but also tolerable, favorable, and essential levels of dissolved materials. Lethal, tolerable, and favorable levels and conditions may be ascertained by: (1) determining the environmental factors and concentrations of materials which are favorable in natural waters; (2) determining by laboratory studies the relative sensitivity of organisms to various environmental factors, and ranges which are tolerable and favorable; (3) determining by means of different bioassay studies the behavioral, physiological, and

other responses of organisms to potential toxicants and concentrations of these materials which are not harmful under continuous exposure; and (4) testing laboratory findings in the field to determine their adequacy for the protection of aquatic and wildlife resources.

Based upon knowledge available at that time, the committee recommended key criteria considered satisfactory for freshwater organisms in the Nation's waters. Selected examples of these original 1968 National criteria appear below:

a. Dissolved materials: Dissolved materials that are relatively innocuous; i.e., their harmful effect is due to osmotic effects at high concentrations, should not be increased by more than one-third of the concentration that is characteristic of the natural condition of the subject water. In no instance should the concentration of total dissolved materials exceed 1500 mg/l NaCl.

b. pH, Alkalinity, Acidity:

(1) No highly dissociated materials should be added in quantities sufficient to lower the pH below 6.0 or to raise the pH above 9.0.

(2) To protect the carbonate system and thus the productivity of the water, acid should not be added in sufficient quantity to lower the total alkalinity to less than 20 mg/l.

(3) The addition of weakly dissociated acids and alkalies should be regulated in terms of their own toxicities as established by bioassay procedures.

c. Dissolved Oxygen: The following environmental conditions are considered essential for maintaining native populations of fish and other aquatic life. For a diversified warm-water biota, including game fish, DO concentration should be above 5 mg/l, assuming normal seasonal and daily variations are above this concentration. Under extreme conditions, however, they may range between 5 and 4 mg/l for short periods during any 24-hour period, provided that the water quality is favorable in all other respects. In stratified lakes, the DO requirements may not apply to the hypolimnion. In shallow unstratified lakes, they should apply to the entire circulation water mass....

d. Turbidity:

(1) Turbidity in the receiving waters due to the discharge of wastes should not exceed 50 Jackson units in warm-water streams....

(2) There should be no discharge to warm-water lakes which would cause turbidities exceeding 25 Jackson units.

Section I of the above report dealt with water quality criteria for recreation and esthetics. The concepts evaluated and criteria established by the Committee for primary contact recreation are also useful for current water quality management planning. The following are pertinent example excerpts from the above section of this report.

> Two factors, microbiological contamination and pH, are so intimately associated with the health and physical well-being of the primary contact recreation user that they should be considered in the management of waters for use for these purposes....
>
> Time factors, multiplicity, and complexity of tests, economics of equipment, and other materials, and manpower requirements rule out use of pathogens as criteria for general application. The optimum solution then becomes one of monitoring an indicator organism....
>
> The feces and urine of warmblooded animals are the most significant potential sources of waterborne pathogens capable of infecting man. Man has contracted cholera, typhoid, leptospirosis, schistosomiasis, and other diseases, with water as the vector, where the source of contamination was traced to animals. Time lapse and magnitude of contamination are critical factors in the degree of the hazard....
>
> Approximately 95 percent of the total coliform organisms in the feces of both birds and mammals yield positive fecal coliform tests. A similar portion of the total coliform organisms in samples of uncontaminated soils and plant materials yield negative fecal coliform tests....
>
> The use of total coliforms as an indicator has a long history,... While the total coliforms count may be a satisfactory indicator in certain respects, the Subcommittee believes that the variable correlation of total coliform content with contamination by excreta suggests that coliforms are not a satisfactory indicator of the possible presence of pathogens in recreational waters.
>
> The portion of the total coliforms in water that is of fecal origin may range from less than 1 percent to more than 90 percent. At the 1 percent level, a limit of 1,000/100 ml total coliforms would constitute an undue limitation on availability of water for contact recreation. At the 90 percent level, a limit of 1,000/100 ml would constitute a threat to the health of the contact recreation user. Thus total coliform criteria are not adequate for determining suitability of waters for use for contact recreation.
>
> Fecal streptococci in combination with total coliforms are being used in sanitary evaluation. Selection of techniques to be applied and the interpretation of results are in a state of flux and uncertainty. Problems include the unresolved question of

whether or not all types of fecal streptococci found in warm-blooded animals are revealed by the tests, the fact that appreciable numbers of streptococci from other sources (plants and insects) yield positive results, and added time and manpower requirements for monitoring agencies. Fecal streptococci should not be used as primary criteria, but are useful as a supplement to fecal coliforms where more precise determination of sources of contamination is necessary....

There is an urgent need for research to refine correlations of various indicator organisms, including fecal coliforms, to waterborne disease....

Recommendation: Fecal coliforms should be used as the indicator organism for evaluating microbiological suitability of recreation waters. As determined by multiple-tube fermentation or membrane filter procedures and based on a minimum of not less than five samples taken over not more than a 30-day period, the fecal coliform content of primary contact recreation waters shall not exceed a log mean of 200/100 ml, nor shall more than 10 percent of total samples during any 30-day period exceed 400/100 ml....

In addition to sanitary criteria, the Subcommittee recommends criteria on pH for primary contact recreation. While the Subcommittee recognizes that many waters (marine, naturally alkaline, or acidic fresh waters) cause eye irritation, the relation of pH to eye irritation justifies inclusion of pH criteria to enhance recreation enjoyment where pH can be controlled....

Recommendation: In primary contact recreation waters, the pH should be within the range of 6.5-8.3 except when due to natural causes and in no case shall be less than 5.0 nor more than 9.0. When pH is less than 6.5 or more than 8.3, discharge of substances which would increase the buffering capacity of the water should be limited.

The above water quality criteria developed by the National Technical Advisory Committee to the Secretary of the Interior in the 1960's were predicated upon available knowledge. The committee's report noted that some of the available knowledge consisted of findings of very limited numbers of studies. Moreover, the criteria were developed for nationwide use, and unique aspects of localized conditions often could not be given adequate attention.

These Federal water quality criteria generally have been used, expanded upon, or replaced in current Florida receiving water quality standards, but some Florida standards still closely parallel the above knowledge. In some cases, the criteria are fully adequate as Florida standards. In other cases, some criteria may have been adopted as Florida standards due to inadequate knowledge of more appropriate water quality criteria, measurement limitations, and other technical and economic constraints. In considering the preparation of an interim water quality management plan for the St. Johns River, it is necessary to recognize that Florida Receiving Water Quality Standards (Appendix B), in large part, have been based upon the above described types of criteria. These criteria provide currently useful and practical guidance for protecting the public health and certain fish and wildlife resources. However, such standards cannot be expected to represent total or final understandings or bases upon which to establish a concept, policy, or determination regarding ambient water quality conditions in the St. Johns River.

Knowledge of the studies and other bases upon which water quality criteria are established prior to their adoption as State standards provides useful guidance for short- and long-range water quality management planning efforts. Short-range regulatory efforts should be based upon existing Florida Water Quality Standards. Where existing standards may be incomplete, such as with regard to estuarine conditions and some natural area ambient conditions, technical studies to develop new knowledge may be beneficially included in longer range regulatory management efforts. Continuing technical evaluation of the effectiveness of existing water quality criteria and standards used as bases for decision making would appear to be appropriate activities of water quality management planning efforts in the St. Johns River Basin.

Water Quality Data

Current Data Collection Programs. Water quality data have been accumulated by various groups and agencies in the St. Johns River Basin for a number of years and for numerous purposes. Generally, water quality data are obtained to determine the quality of water for selected uses or to determine effluent or receiving water conditions. Until very recently, standardized procedures for water sample collection, preservation, and analysis were not given emphasis and often were followed with varying degrees of effectiveness. As a result, data collected before the mid-1970's may be subject to higher degrees of total error than is characteristic for currently collected data.

Proprietary water quality data are routinely obtained for industries and agricultural activities in the basin, but the extent and availability of this information is generally unknown. Groundwater quality data from a sample well network are maintained by the U.S. Geological Survey. The Florida Department of Environmental Regulation and local government agencies obtain utility supplied potable water quality data. The U.S. Geological Survey and the U.S. Army Corps of Engineers are the two Federal agencies that conduct routine sampling within the basin. The Florida Department of Environmental Regulation conducts extensive sampling throughout the basin, and the Florida Game and Fresh Water Fish Commission has conducted a long-term sampling program on the St. Johns River. The St. Johns River Water

Management District has also established a water column sampling program within the basin that will be expanded as the District's water quality management program becomes established. Additionally, at least eight local government agencies routinely sample waters within their jurisdictions.

Each of the agencies obtaining water quality samples within the basin do so in response to legislative or other authorizations. Agency needs dictate the manner in which a water sampling program is carried out. The resultant data can be expected to have varying degrees of utility for other purposes. However, through improved coordination among agencies collecting data, some sampling redundancies can be eliminated. Additionally, improved cost-effectiveness can result from greater standardization of sampling procedures and parameters evaluated by the sampling agencies. This could be accomplished through interagency data exchange agreements.

Through this study, the St. Johns River Water Management District identified the major governmental sources of available water quality data, developed a data base system using the U.S. Environmental Protection Agency STORET system, and incorporated readily available data into the system. This effort has provided the SJRWMD with the opportunity to review available data and determine next steps in the extension of their basic data collection efforts. Their current efforts are oriented towards the establishment of collection programs to close basic data gaps in previously determined problem areas within the basin.

Locally Identified Concerns and Data Needs. As an initial planning effort, the St. Johns River Management District has identified the following six general areas of water quality management concerns and data needs in the St. Johns River Basin. These include:

a. Inadequate data and monitoring program in the documented problem area of Lake Jessup;

b. Data gaps in parametric monitoring (pesticide data for agricultural areas, trace metals, and flow data);

c. Data gaps in biological monitoring (limiting nutrients, lake tropic states, and macrobenthic data);

d. Inadequate information on stormwater runoff problems throughout the basin and concern for the adequacy of current stormwater regulations for achieving water quality goals;

e. Concern for the adequacy of current nutrient waste load allocations; and

f. Inadequacy of available data to permit effective utilization of predictive water quality models.

The above listing contains a synthesis of concerns from several state and local agencies with economic development and/or water management responsibilities. The Water Management District has identified the Lake Jessup locality as a major problem area where hyper-eutrophic water quality conditions are being further impacted by numerous nonpoint agricultural and urban development sources. Concerns also reflect the potential of degraded water quality conditions from the lake that may be impacting the St. Johns River system receiving waters. The Water Management District considers that effluents from this rapidly developing area may be adversely impacting the water quality in this part of the Middle St. Johns River Basin, but very little technical information is currently available for this area.

Local investigation resources are not presently sufficient for undertaking the comprehensive evaluations required to determine the existing conditions within the Lake Jessup impacted area. Similarly, local resources are not adequate for undertaking a systematic program to establish ambient water quality conditions within this part of the basin. The presented listing of local concerns appears in this report to indicate the general character of local concerns. Through interagency coordination efforts, further definition and ranking of these concerns may be beneficial.

Maintenance and enhancement of the water quality in the St. Johns River are essential for assuring long-term economic development and growth potentials within the basin. It is not presently possible to quantify the benefits of improved water quality conditions and the broad range of increased social and economic benefits resulting from these ends. Existing water quality conditions within the river system reflect natural conditions, unmeasured nonpoint pollution, and regulated point source discharges. Presently, the Water Management District is concerned that effluents from point and nonpoint sources, in some localities, may be exceeding the river system's ability to assimilate these materials without causing extended areas of hyper-eutrophic conditions. Until improved evaluation capabilities are developed, determination of acceptable levels of effluent discharges will remain conjectural. Excessive regulation is costly and detrimental to local area economic productivity. Ineffective regulation of effluents is detrimental to the public health, area recreation opportunities, and economic activities that depend upon the wholesomeness of the river system.

During this investigation, the City of Jacksonville, as the major water resource user along the St. Johns River, expressed the need to obtain surface water information upon which to base their management decisions. They also expressed the need to expand the present surface water data collection network and to develop improved statistical methods for analyzing surface water data related to State waste load allocations and local regulatory programs. The following are the major water quality data and management program related concerns expressed by the City of Jacksonville:

a. Development is currently exceeding the abilities of existing utilities to provide new service to areas distant from sewage treatment plants (STP's). Currently, 14 tributary streams to the St. Johns River have recurring water quality standards violations. On streams which do not meet standards, moratoriums exist against new discharges, and approximately 170 STP's have received waste treatment allocations which specify the quantities of pollutants they may discharge.

b. Water quality standards continue to be violated by some industrial dischargers on tributaries and within the main stem of the St. Johns River. Primary concerns of environmental regulators relate to the continuing discharges of heavy metals (primarily iron, mercury, and copper) and hydrocarbons (primarily PCB). Residuals from such pollutants can be expected to contaminate water columns for many years due to the persistence of these materials in sediments.

c. The City estimates that about 50 percent of tributary stream pollution originates from nonpoint sources, such as lawns, pastures, and runoff from streets. On some tributaries, nonpoint source loadings result in water quality standards violations even in the absence of point source discharges. The City is concerned that these conditions are not currently being addressed effectively in the State's nonpoint source program.

d. The State recognizes the relationship between upland development and wetland habitat and water quality. Flood plain encroachment by development in Jacksonville is exaggerating impacts of stormwater runoff upon freshwater and estuarine wetlands.

e. The surface water monitoring program needs to be expanded to include hydrological information on streams tributary to the St. Johns River, major portions of which are tidal.

Data Development Constraints. Water quality management is heavily dependent upon field investigations and the collection and analysis of water samples. Effectively conducted, water quality investigations are complex undertakings, very costly, subject to sample analysis results variability, and produce results that are sometimes inconclusive or difficult to interpret. Technical analysts recognize the high potentials for results variability in collected field and laboratory data. Each analyst develops an individual understanding of the significance to be given selected parameters of given water quality samples based upon personal knowledge of given water bodies. The need exists for improved standardization in the water quality analysis process -- program design, collection, analysis, and interpretation.

To determine loadings of pollutants entering water courses from various types of land uses or natural areas, field sampling data would have to be collected periodically from the beginning of the runoff period from a storm event through the end of that event. To develop statistical reliability of such data, similar collections should be made for storm events of various intensities and durations from a number of comparable land use or natural areas. The extreme difficulties of placing field teams at necessary sampling sites for the critical periods during storm runoff events have severely limited the development of fundamental technical knowledge upon which to base effective water quality management decisions. The extent to which such studies have been conducted in the St. Johns River Basin remains to be determined. Most water quality sampling typically has been conducted to develop average or general water body characteristic information, often on monthly or longer timeframe periodic bases. Even the process of obtaining such more generalized data are complex, costly, and subject to random technical problems and judgmental errors.

In recent years, instrumentation for field measurements and laboratory analyses has improved markedly. However, all analysis procedures are subject to differing levels of normal results variability. As a result of increasing concerns for the need to monitor for traces of toxic substances in pollutants, very sophisticated laboratory analyses of water samples are required. While costs for such analyses have been declining with advances in the technology, costs for analysis of single water samples are still high. Typical laboratory costs at the Corps of Engineers regional laboratory in Atlanta, Georgia, are on the order of $10 to $20 per parameter, and the analysis of 30 or more parameters in single water samples is common. Laboratory analysis costs of the U.S. Environmental Protection Agency's 129 priority toxic substances have been variously reported to range from $1,000 to $2,000 per water sample.

Ambient water quality evaluations are complex and require specialists trained in a spectrum of physical science disciplines. An overall understanding of factors that influence water quality in the St. Johns River requires technical understandings including knowledge of: area meterology and climatology; geochemistry with emphasis upon water chemistry; geology, soils, and vegetation biogeochemical interactions; and biological productivity with an emphasis in biochemistry. This broad spectrum of capabilities is generally not available for application to the understanding of natural water conditions within the St. Johns River. All data collection agencies have limited capabilities and resources, and these are largely devoted to current regulatory program activities.

Initial Analysis Procedures. Because of high sampling costs and inherent variability of water column data, unique existing locality characteristics and acute problem areas often can be more effectively established through sediment and benthic/sessile organism analyses, including trace metals. Sediment chemistry changes much more slowly than conditions in the water column and provides a more stable indication of long-term impacts of transported materials to and through a given water body area. Analyses of water column materials provides very useful information on local area and shorter-term water quality conditions. Data deviations from geochemical norms would provide indications of more intensive investigation needs.

Careful development of a sediment analysis sampling program for the Federal waterways parts of the St. Johns River would provide base data on existing sediment and organism constituents that could be used for future statistical correlation studies within parts of the basin and in other comparative waterways in Florida.

Data base information for statistical analyses would have to be obtained for fresh water areas, connate saline waters, and estaurine waters in the St. Johns River. These sets of base data would provide means for gradually relating the impacts of sediments transfer from secondary streams into the St. Johns Rivers. When unusual conditions were found, combined water column and sediment analyses of potential deviation areas would have to be undertaken. Determination of these needs would be coordinated with initial sediment sampling program requirements and selection of hydrodynamic evaluation procedures.

The existing stream flow gaging data for the St. Johns River are inadequate and would have to be supplemented to establish river system hydrodynamic characteristics. Additional evaluations also would be needed to determine major tributary streams' flow discharge dispersions into the St. Johns River, as modified by flow pulses and reverse flows resulting from tidal influences. Analyses would have to be conducted for high freshwater discharge periods and drought no-flow conditions to determine secondary circulation patterns within the extremely large and elongated Lower Basin estuary. Within the Middle Basin, the extent of groundwater spring flow and/or seepage along and within the river channel also would have to be determined as part of the system's hydrodynamic characteristics evaluations. Efforts to develop mathematical models to provide reasonable information upon which to base management decisions have been underway for a number of years. Due to their simplification of complex natural processes, these tools also have limitations but can provide improved knowledge of selected hydrodynamic processes and water quality constituent variability. The application of modeling technology to water quality problems in the St. Johns River Basin is a fundamental process through which a more complete environmental assessment of the river system is possible.

Between 1974 and 1980, the Corps of Engineers conducted a comprehensive investigation of water resource problems in the Jacksonville, Florida, Metropolitan Area. A substantial part of this investigation focused upon wastewater and water quality management problems within the region. As part of that investigation, a refined mathematical water quality model based upon available hydrodynamic information on the lower St. Johns River from Palatka to its mouth was developed. Other mathematical water quality modeling efforts were used to investigate conditions along several of the area's streams tributary to the St. Johns River. Since that time, improved information was developed on the lower St. Johns River hydrodynamic behavior through a hydaulic model constructed for the Jacksonville Harbor Mill Cove project investigation. As part of the Corps investigations for the Upper St. Johns River Basin Flood Control Project, a two component mathematical model was used to simulate flood flows on the river between river mile points 279 and 191. The St. Johns River Water Management District has developed a parallel mathematical model for this same part of the river that has now been calibrated to replicate probable high and low flows. No work has apparently been undertaken to analytically correlate flow and water quality data for this part of the river system. Review of these evaluation procedures would be needed to select appropriate analytical methods essential for evaluation of Federal waterways associated with the St. Johns River Middle and Lower Basins.

Watershed Analyses. While the initial study efforts would focus upon the St. Johns River, environmental assessments to identify water quality contributions from selected natural areas and land uses adjacent to the river and in tributary stream watersheds would be needed. The Corps of Engineers has developed various analyses procedures for estimating flow characteristics of streams and runoff from watersheds. However, as previously noted, practical means of measuring pollutant loads from nonpoint sources for given storm conditions is difficult. Attempts to develop analytical results based upon generalized or average pollutant loadings in runoff from watersheds may have some use, but such procedures should be expected to often provide spurious results.

Great care would have to be taken in determining representative watershed physical and land cover characteristics, hydrological conditions, geochemistry processes, and pollutant constituent loading rates. The development of more standardized procedures for this analytical process would be a necessary elementary step before any degree of consistency and reliability in analysis results could be expected. The structuring of standardized procedures for these purposes before data development were attempted would have to be an early study effort. Once reasonably standard data development procedures were established, it still would be necessary to train analytical personnel in methods for achieving comparative results.

The categorization, delineation, and quantitative representation of natural land areas and land uses are still undertaken very subjectively. The process is technically tedious and is given little attention in analyst training. As a result, land area analysis limitations greatly restrict the current usefulness of watershed runoff/water quality analysis procedures. Procedures refinement efforts are needed to establish more reliable and cost-effective means for obtaining reasonable runoff/water quality approximations from land areas within watersheds.

Because of the above analysis limitations, any continuation of this investigation would restrict watershed analyses to selected direct runoff areas to the St. Johns River. Sets of data would be obtained from selected land areas for the purpose of establishing most probable ranges for water quality parameters in samples from these areas. Established statistical sampling procedures would be used for this evaluation process. Data also would be obtained for discharge areas from secondary watersheds to establish water constituents and flow dispersion into the St. Johns River. Sufficient discharge data would be obtained to establish probable ranges for flows and water quality to be expected from these areas under normal seasonal conditions. No efforts would be made, at this time, to conduct field investigations of all tributary stream discharge points. Instead, established estimation procedures would be used for those streams not evaluated in this investigation.

Opportunities

This study has permitted a restatement and clarification of critical water resource management concerns within the St. Johns River Basin. The study has already provided a mechanism through which the St. Johns River Water Management District has been able to establish a data base for use in its water quality management planning efforts. The development of the data base also has been instrumental in improving coordination among agencies with water quality data collection responsibilities within the basin.

Continuation of this study would provide valuable hydrodynamic and environmental base information not presently available for the St. Johns River Middle and Lower Basins. The environmental assessment needs documented in this report would provide essential information on existing water quality conditions within the Federal waterway parts of the St. Johns River system. These waterways have been utilized for many years, but little information has been assembled to determine impacts of works and their operations on flow and water quality conditions in the St. Johns River. Continuation of this investigation would provide an oportunity to determine whether further modifications to Federal projects or project-related measures are warranted. The data and information obtained would serve as valuable base data against which potential future impacts of water usage could be measured.

The continuation of this investigation also would permit the establishment of base data on the St. Johns River for project review purposes and application of this existing Federal water resource technology to the area's water quality problems that is presently not available within the water management district's capabilities. Such a Federal Government transfer of water resource management technology to the State for improving basin-wide water resource and water quality management efforts could be expected to greatly enhance the State's ability to ensure the long-term adequacy of water of reasonable quality within the St. Johns River Basin.

STUDY CONSTRAINTS

INTRODUCTION

Primary Federal responsibility for maintaining the quality of the Nation's waters rests with the U.S. Environmental Protection Agency. The traditional Federal responsibilities of the U.S. Army Corps of Engineers regarding water quality have been restricted to maintaining water quality with regard to the water resource projects it undertakes. The Corps has a broad range of experience in dealing with water resource problems in the St. Johns River Basin and extensive capabilities that could be applied to the establishment of comprehensive information on the ambient water quality of the St. Johns River. However, the concept of an interim water quality management plan for the St. Johns River Basin has been addressed under the authority of Public Law 98-50 through which funds were provided for this investigation.

AGENCY RESPONSIBILITIES

Corps of Engineers

Federal legislation establishes general Corps of Engineers Civil Works responsibilities and authorizes technical assistance to be provided to resolve local area problems on a project-by-project basis. Corps responsibilities for undertaking basinwide and comprehensive water quality management planning had not been previously established by Federal legislation, although aspects of such planning have been integral to Corps project efforts. While the Corps of Engineers' primary Civil Works mission is oriented towards the protection and enhancement of the Nation's water resources to ensure a viable national economy, every element of the Civil Works Program is also, in varying degrees, concerned with project related water quality management. Every Corps' study conducted to evaluate locally identified water resource problems incorporates some water quality considerations in each stage or phase of a problem investigation. When investigations lead to structural or nonstructural project alternatives for alleviating an identified problem, water quality concerns influence Corps decisions throughout project planning and construction project development phases. Upon project completion, project operations and maintenance programs are carried out with appropriate regard for potential water quality impacts of these efforts. Because of these general Corps concerns, the Prior Federal Studies and Reports section includes reference to all identifiable Corps' investigations conducted within the St. Johns River Basin.

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT (SJRWMD) RESPONSIBILITIES

The St. Johns River Water Mangement District (SJRWMD) is the agency of the State of Florida that would be the local sponsor for study continuation purposes. This agency has primary responsibilities for assuring that adequate water of suitable quality is available for the needs of the population residing within the District and for fish and wildlife and environmental protection. The District operates under responsibilities set forth in Chapter 373, Florida Statutes. This chapter includes State legislative directives set forth in the Florida Water Resources Act of 1972 and its amendments. Under this Act, the District is empowered to: permit and regulate consumptive uses of surface and underground water; construct, repair, or abandon wells; and construct, repair, and operate impoundments, reservoirs, and other surface water managment systems, including drainage systems.

The District's primary responsibility is to ensure the adequacy of water supplies within the District. Chapter 403, Florida Statutes, gives the Florida Department of Environmental Regulation (DER) the responsibility for controlling and prohibiting water pollution, including the discharge of dredged and fill materials in waters and wetlands of the State. The water quality standards promulgated under this act are set forth in Chapter 17-3, Florida Administrative Code (Appendix B).

While the primary responsibility of the District under Chapter 373, Florida Statutes, is the management of water quantity, the Attorney General's Opinion, Number 75-16, recognized that in the protection of water resources of a District, the District must also impose the necessary conditions to ensure that permitted activities do not degrade water quality. This opinion concluded that the authority to control water quality does not reside exclusively with a District, but a District's permitting procedures must take water quality into consideration to properly effect the purposes of Chapter 373.

PRIOR AND ONGOING STUDIES

Prior Federal Studies and Reports

The St. Johns River Basin has been included in many River and Harbor Acts dating from the latter part of the 19th Century (plates 2, 3, and 4). These Acts are presented in table 3. The existing federally authorized flood damage prevention project works and Federal navigation projects considered for review in this investigation are presented in table 4.

Investigations for Mill Cove were covered under two Section 107 Reports. In 1970, a recreational small boat channel was considered through Mill Cove but was found to be not feasible. A study in 1974 indicated favorable findings for a similar channel but there was no local sponsor for the project. These reports ended with no recommendation for further action. A feasibility report was written on Jacksonville Harbor-Mill Cove dated September 1980. The investigation was conducted to determine whether the existing Jacksonville Harbor Project resulted in degradation of Mill Cove and the need for improvements for circulation, flow, and navigation.

Another Section 107 Report was written for Stokes Landing. The purpose of the study was to investigate the feasibility of providing a Federal navigation channel from the St. Johns River to Stokes Landing near Palatka. This study was discontinued in 1982 due to lack of interest by the local sponsor.

TABLE 3

RIVERS AND HARBORS ACTS

Act	Work Authorized	Document
14 June 1880	Contemplated a channel over Volusia Bar with a 15-foot depth at mean low water Jetties at entrance (maintenance only)	Annual Report for 1879, page 767
14 July 1880	Improving Volusia Bar - called for two jetties on the bar and a 6-foot deep channel	
5 July 1884	Improvement between Lakes George and Monroe	
13 July 1892	Secure 15-foot depth through the reach from Dames Point to Mile Point	
3 June 1896	Channel 300 feet wide and 24 feet deep from Jacksonville to the ocean with extending jetties	House Document No. 346, 53rd Congress, 3rd Session
3 March 1899	200-foot-wide, 13-foot-deep channel from Jacksonville to Palatka	House Document No. 523, 55th Congress, 2nd Session
13 June 1902	Maintenance of improvement at Volusia Bar and maintain a 5-foot-deep channel between Palatka and Sanford	
2 March 1907	A depth of 24 feet at mean low water between the 24-foot curve and the pierhead line at Jacksonville	House Document No. 663, 59th Congress, 1st Session
25 June 1910	A channel 100 feet wide and 8 feet deep from Palatka to Sanford with a side channel to Enterprise and thence 5 feet deep to Lake Harney	House Document No. 1111, 61st Congress, 2nd Session
25 June 1910	Main channel, 30 feet deep at mean low water and in general 300 feet wide, and the anchorage basin opposite Mayport	House Document No. 611, 61st Congress, 2nd Session

TABLE 3 (continued)

Act	Work Authorized	Document
4 March 1913	Provided for a channel 100 feet wide and 8 feet deep from the St. Johns to Crescent City	House Document No. 1320, 62nd Congress, 3rd Session
2 March 1919	Improvement to Deep Creek	House Document No. 699, 63rd Congress, 2nd Session
5 June 1920	Present project effected by the consolidation of former projects	Specified in Act
3 July 1930	Cutoffs at Butcher Bend, Snake Creek and Starks and easing bends at other points	House Document No. 691, 69th Congress, 2nd Session
3 July 1930	Widening the bend at Dames Point	House Document No. 483, 70th Congress, 2nd Session
30 August 1935	Widening Drummond Creek, Trout Creek, and Six Mile Creek, cuts to 400 feet and a channel 30 feet deep and 400 feet wide along the terminals at Jacksonville	Senate Committee 74th Congress, 1st Session
2 March 1945	A channel 10 feet deep and 100 feet wide from Palatka to Sanford, with a side channel to Enterprise, and with side cutoffs and easing of bends	House Document No. 603, 76th Congress, 3rd Session
2 March 1945	Maintenance of existing channel widths; widening Terminal Channel to 590 feet; the 28-foot area between Laura Street and St. Elmo West Acosta Bridge; channel along south side of Commodore Point; and basin at Naval Reserve Armory	House Document No. 322, 77th Congress, 1st Session
2 March 1945	Main channel 34 feet deep via Terminal Channel	Senate Document No. 230, 78th Congress, 2nd Session

TABLE 3 (continued)

Act	Work Authorized	Document
2 March 1945	Combining two previous Acts (3/2/45 and 7/3/30) into a single project for the St. Johns River, Jacksonville to Lake Harney, and for a cutoff 5 feet deep and 75 feet wide between Lake Monroe and the vicinity of Osteen Bridge (Woodruff Creek Cutoff)	House Document No. 445, 78th Congress, 2nd Session
2 March 1945	Dame Point - Fulton Cutoff 34 by 500 feet	Senate Document No. 179, 79th Congress, 2nd Session
24 July 1946	A channel 12 feet deep and 100 feet wide from Palatka to Sanford and in the branch to Enterprise	Senate Document No. 208, 79th Congress,
27 October 1965	Maintain existing entrance channel depths of 40 and 42 feet; deepen main ship channel to 38-foot depth to Mile 20; and widen channel near Mile 5 and Mile 7	House Document No. 214, 89th Congress

TABLE 4

ST. JOHNS RIVER
SURVEY REPORTS AND PRELIMINARY EXAMINATIONS

Date	Report	Recommendations[1]	Recommendations[1] of the Chief of Engineers	Documents
24 May 1853	Survey Report and Fort George Inlet			
29 January 1869	Survey Report Mouth			Annual Report of Chief of Engineer 1869, page 266
25 March 1872	Survey Report Jacksonville to the ocean			Annual Report of Chief of Engineer 1872, page 672
16 July 1878	Survey Report Between Lakes Monroe and George	F		Annual Report of Chief of Engineer 1879, page 795
16 July 1878	Survey Report Volusia Bar	F		Annual Report of Chief of Engineer 1879, page 795
30 June 1879	Survey Report Mouth	F		Annual Report of Chief of Engineer 1879, page 767, with maps
23 May 1882	Survey Report To Charlotte Harbor or Peace Creek via Topokalija Lake, waterway			Senate Ex. No. 1 47th Congress, 1s Session, Annual Report of Chief o Engineers 1882, page 1204
9 January 1883	Preliminary Examination	F		
5 October 1883	Survey Report At entrance to and exit from Lake Monroe and between Lakes George and Monroe			Senate Ex. No. 6 48th Congress, 1s Session, Annual Report of Chief o Engineers 1884, page 1138

TABLE 4 (continued)

ST. JOHNS RIVER
SURVEY REPORTS AND PRELIMINARY EXAMINATIONS

Date	Report	Recommendations[1]	Recommendations[1] of the Chief of Engineers	Documents
3 November 1884	Preliminary Examination to Jupiter Inlet and Lake Worth, Waterway, via Mosquito Lagoon, and Indian River	F		Annual Report of Chief of Engineers 1885, page 1291
26 January 1891	Preliminary Examination Upper, from Lake Monroe southward	U	U	House Ex. No. 240, 51st Congress, 2nd Session, Annual Report of Chief of Engineers 1891, page 1666
26 January 1891	Preliminary Examination Jacksonville to Sanford and near Orange Mills	U	U	House Ex. No. 240, 51st Congress, 2nd Session, Annual Report of Chief of Engineers 1891, page 1666
18 February 1895	Survey Report Jacksonville to the ocean	F		House Ex. No. 346, 53rd Congress, 3rd Session, Annual Report 1895, page 1586
23 February 1895	Preliminary Examination At Orange Mills Flat near Palatka	U		House Ex. No. 347, 53rd Congress, 3rd Session, Annual Report 1895, page 1560
30 May 1898	Survey Report At Orange Mills Flat near Palatka	F		House No. 523, 55th Congress, 2nd Session, Annual Report 1898, page 1343
4 December 1905	Survey Report St. Johns River	F	F	House No. 663, 59th Congress, 1st Session

TABLE 4 (continued)

ST. JOHNS RIVER
SURVEY REPORTS AND PRELIMINARY EXAMINATIONS

Date	Report	Recommendations[1]	Recommendations[1] of the Chief of Engineers	Documents
3 June 1907	Preliminary Examination To Sanford Sanford to Lake Harney	F		House No. 1111, 60th Congress, 2nd Session
1 October 1908	Survey Report To Sanford Sanford to Lake Harney	F	F	House No. 1111, 60th Congress, 2nd Session
30 April 1909 22 November 1909	Preliminary Examination Survey Report Jacksonville to the Ocean	F F	 F	House No. 611, 61st Congress, 2nd Session, with maps
5 May 1911	Preliminary Examination Channel through Dexter and Woodruff Lakes	U	U	House No. 252, 63rd Congress, 1st Session
29 May 1911	Preliminary Examination Jacksonville to Palatka	U	U	House No. 281, 62nd Congress, 2nd Session
12 July 1911 7 November 1911	Preliminary Examination Survey Report To Cumberland Sound	U F	 F	House No. 898, 62nd Congress, 2nd Session
15 July 1911	Preliminary Examination St. Johns River, Florida	F	U	House No. 493, 62nd Congress, 2nd Session
18 December 1912	Preliminary Examination Lake Harney to Lake Washington	U	U	House No. 1397, 62nd Congress, 3rd Session
5 June 1913	Preliminary Examination Canal to Lake Beresford	U	U	House No. 208, 63rd Congress, 1st Session
26 October 1916	Preliminary Examination To Key West, Florida (Florida East Coast Canal)	U	U	House No. 1147, 65th Congress, 2nd Session

TABLE 4 (continued)

ST. JOHNS RIVER
SURVEY REPORTS AND PRELIMINARY EXAMINATIONS

Date	Report	Recommendations[1]	Recommendations[1] of the Chief of Engineers	Documents
29 April 1922 4 March 1926	Preliminary Examination Survey Report Jacksonville to Sanford	F F		House No. 483, 70th Congress, 2nd Session
15 March 1924 30 October 1926	Preliminary Examination Survey Report Jacksonville to Sanford	F U	 F	House No. 691, 69st Congress, 2nd Session
9 November 1926 29 August 1939	Preliminary Examination Survey Report	U F	 F	House No. 603, 76th Congress, 3rd Session
20 April 1928	Preliminary Examination To Indian River, Florida, channel from Sanford to near Titusville	U	U	Not published
28 November 1933	Preliminary Examination To Indian River, Florida, channel from Sanford to near Titusville	F	U	Not published
1 November 1930 15 May 1931	Preliminary Examination Survey Report Erosion at Dames Point and New Berlin	F U	 U	 Not published
2 February 1931	Preliminary Examination Lake Harney to Lake Washington	U	U	Not published
3 June 1935	Survey Report Jacksonville to the Ocean			

TABLE 4 (continued)

ST. JOHNS RIVER
SURVEY REPORTS AND PRELIMINARY EXAMINATIONS

Date	Report	Recommendations(1)	Recommendations(1) of the Chief of Engineers	Documents
15 July 1935	Survey Report To Indian River, Florida Channel from Sanford to near Titusville	U	U	Not published
26 March 1936	Preliminary Examination To DeLeon Springs, waterway	U	U	Not published
22 October 1936	Preliminary Examination St. Johns River, Florida	U	U	Not published
6 December 1938	Preliminary Examination Sanford to Tampa, Florida, waterway	F	U	Not published
7 September 1939	Survey Report To Lake Beresford, Florida	U	U	Not published
19 November 1940	Survey Report Jacksonville to the ocean	F	F	House No. 322, 77th Congress, 1st Session
11 December 1943	Survey Report Jacksonville to Lake Harney		F	House No. 445, 78th Congress, 2nd Session
23 May 1944	Survey Report Jacksonville to ocean 35-foot channel		F	Senate No. 230, 78th Congress, 2nd Session
9 August 1945	Survey Report Jacksonville to the ocean		F	Senate No. 179, 79th Congress, 2nd Session
10 April 1946	Survey Report		F	Senate No. 208, 79th Congress, 2nd Session

TABLE 4 (continued)

ST. JOHNS RIVER
SURVEY REPORTS AND PRELIMINARY EXAMINATIONS

Date	Report	Recommendations(1)	Recommendations(1) of the Chief of Engineers	Documents
26 December 1950	Preliminary Examination Jacksonville to the ocean		U	Not published
23 January 1953	Preliminary Examination St. Johns River, Florida		U	Not published
	RICE CREEK			
3 July 1947	Preliminary Examinaiton	F		House No. 446, 82nd Congress, 2nd Session
14 January 1952	Survey Report Putnam County, Florida		F	
29 October 1951	Preliminary Examination Rice Creek, Florida	U		Not published
	OKLAWAHA RIVER			
7 February 1889	Survey Report	F	F	Annual Report of Chief of Engineers 1889, page 1360
5 September 1905	Preliminary Examination	F		House No. 782, 59th Congress, 1st Session
16 April 1906	Survey Report	F	F	
29 December 1911	Preliminary Examination	F		House No. 514, 63rd Congress, 2nd Session, (with maps)
21 January 1913		F	F	
27 February 1917	Survey Reports	F	F	House Committee No. 1, 65th Congress, 1st Session

TABLE 4 (continued)

ST. JOHNS RIVER
SURVEY REPORTS AND PRELIMINARY EXAMINATIONS

Date	Report	Recommendations[1]	Recommendations[1] of the Chief of Engineers	Documents
23 January 1953	Preliminary Examination		U	Not published
	WEKIVA RIVER			
3 November 1884	Preliminary Examination	U		House Ex. No. 71, 48th Congress, 2nd Session, Annual Report of Chief of Engineers 1885, page 1281
6 June 1907	Preliminary Examination	U	U	House No. 532, 60th Congress, 1st Session
20 May 1911	Preliminary Examination	U	U	House No. 271, 63rd Congress, 1st Session
29 May 1927	Preliminary Examination	U	U	Not published

(1) F = Favorable; U = Unfavorable

A Water Resources Study of Metropolitan Jacksonville, Florida, was completed in August 1980, with the final report prepared in 11 volumes:

1. Summary Report

2. Background Information Appendix

3. Annex I - Base Condition Analysis

4. Annex II - Supporting Appendixes

5. Plan Formulation Appendix

6. Annex I - Area Wide Wastewater Management

7. Supplement A - Water Quality Modeling

8. Annex II - Water Supply Management

9. Annex III - Flood Plain Management

10. Annex IV - Small Boat Navigation Assessment

11. Public Involvement and Comments Appendix

The Upper St. Johns River Basin flood control problems have been studied since the 1950's as part of the Central and Southern Florida Project. The most recent information is contained in the Central and Southern Florida Project Part III, Upper St. Johns River Basin, Addendum 3 with Environmental Impact Statement. This investigation includes extensive water quality studies. A listing of all prior studies on the Upper St. Johns is given in table 5.

TABLE 5

FEASIBILITY REPORTS ON THE UPPER ST. JOHNS RIVER BASIN
(SURVEY REPORT AND GENERAL DESIGN MEMORANDUMS)
CENTRAL AND SOUTHERN FLORIDA PROJECT
FOR FLOOD CONTROL AND OTHER PURPOSES

Date	Type of Report	Item(s) Covered by Report
30 June 48	Survey Report House Document 643, approved in Public Law 858, 80th Congress, 2d Session	Initial authorizations for Central and Southern Florida Project, including preliminary plan of improvement for Upper St. Johns River Basin, but without authorization for Upper St. Johns River part.

TABLE 5 (Continued)

FEASIBILITY REPORTS ON THE UPPER ST. JOHNS RIVER BASIN
(SURVEY REPORT AND GENERAL DESIGN MEMORANDUMS)
CENTRAL AND SOUTHERN FLORIDA PROJECT
FOR FLOOD CONTROL AND OTHER PURPOSES

Date	Type of Report	Item(s) Covered by Report
3 Sep 54	Survey Report House Document 643, 80th Congress, 2d Session	Authorization for previously developed plan of improvement for Upper St. Johns River Basin and related areas project. (This authorization specifically recognized that the plan of improvement would require refinement and that modifications within the scope and purpose of the authorization could be made at the direction of the Chief of Engineers.)
20 Mar 57	Part III, Supplement 2, General Design Memorandum Upper St. Johns River Basin	Plan changed; original plan considered inadequate by local sponsor in providing water storage for drought protection.
15 Feb 62	Addendum 1 to Supplement 2, Revised Plan of Improvement	Plan changed at request of local sponsor -- the Central & Southern Florida Flood Control District (now the South Florida Water Management District). Valley storage replaced by upland storage. Parts of proposed water storage areas already developed with plans for improving much of remainder.
17 Mar 69	Addendum 2 to Supplement 2, Modified Plan of Improvement for South Portion	Plan changed in southern portion of basin around Blue Cypress Lake. Some upland storage in Ft. Drum area eliminated. Land development and limited remaining available conservation storage area made storage areas questionable.
6 Oct 70	Survey Report House Document 91-394, 91st Congress, 2nd Session	Authorized modifications to Central and Southern Florida Project to provide for navigation improvements suitable for recreational craft, consisting of locks and channel dredging in the Upper Kissimmee and St. Johns River Basin.

TABLE 5 (Continued)

FEASIBILITY REPORTS ON THE UPPER ST. JOHNS RIVER BASIN
(SURVEY REPORT AND GENERAL DESIGN MEMORANDUMS)
CENTRAL AND SOUTHERN FLORIDA PROJECT
FOR FLOOD CONTROL AND OTHER PURPOSES

Date	Type of Report	Item(s) Covered by Report

DETAILED DESIGN MEMORANDUMS ON THE
UPPER ST. JOHNS RIVER BASIN

Seq.	Part	Supplement	Title	Date
149	III	6	Detail Design Memorandum, Canals 54 and 56 (Sebastian and Poinsett Outlet Canals); Levee 73, Sec. 1 (Taylor Ck. portion of Jane Green Levee); and Structures 55, 96, 157, and 164	12/18/63
173	III	7	Detail Design Memorandum, Levee 73, Section 2, Canals 57 and 58, and Control Structures 161, 162, 163, and 221	2/28/68
181	III	9	Detail Design Memorandum, Levee 72, Control Structure 160, Culverts 1 thru 6	8/18/70

The Cross Florida Barge Canal is a major project within the Oklawaha part of the St. Johns River Basin. This project was undertaken to provide a barge waterway route between the St. Johns River at Palatka and the Gulf of Mexico at Yankeetown, Florida, a distance of about 110 miles. Table 6 contains a listing of previously issued reports on the Barge Canal.

Flood Plain Management Studies

Flood Plain Management Studies conducted for localities in the St. Johns River Basin have included the following brochures:

a. Jacksonville, Florida - March 1969

b. Vicinity of Southeast Volusia County, Florida - June 1972

c. Vincinty of Little Wekiva River - September 1970

d. Lake Monroe Near Sanford, Florida - July 1971

e. Vicinity of Northeast Volusia County, Florida - July 1971

f. Lake Beresford and the St. Johns River, Volusia and Lake Counties, Florida - September 1974

TABLE 6

CROSS-FLORIDA BARGE CANAL
PREVIOUSLY ISSUED REPORTS

Title	Date
Definite Project Report, Cross-Florida Barge Canal	December 1943
Addendum No. 1 to Definite Project Report	March 1945
Economic Restudy of Cross-Florida Barge Canal	10 January 1958
Report entitled "Cross-Florida Barge Canal, Chief of Engineers' Evaluation"	June 1962
Report entitled "Cross-Florida Barge Canal, Supplement to Economic Restudy"	16 August 1963
Detail Design Memorandum No. 1, Cross-Florida Barge Canal, St. Johns Lock	October 1963
Detail Design Memorandum No. 2, Cross-Florida Barge Canal, Relocation of U.S. Route 19	April 1964
Detail Design Memorandum No. 3, Cross-Florida Barge Canal, Inglis Lock	19 May 1964
Detail Design Memorandum No. 4, Cross-Florida Barge Canal, Relocation of State Road 316	19 June 1964
Detail Design Memorandum No. 5, Cross-Florida Barge Canal, Project Office Building	August 1964
Detail Design Memorandum No. 6, Cross-Florida Barge Canal, Rodman Dam	November 1964
Detail Design Memorandum No. 7, Cross-Florida Barge Canal, Eureka Lock and Dam	February 1965
Detail Design Memorandum No. 7A, Cross-Florida Barge Canal, Preliminary Master Plan, Part of the Master Plan	14 October 1965
Detail Design Memorandum No. 8, Cross-Florida Barge Canal, Clearing Rodman Pool	January 1966
Detail Design Memorandum No. 3, Supplement 1, Cross-Florida Barge Canal, Inglis Lock, Cooling Water Bypass Channel	January 1966
Detail Design Memorandum No. 9, Cross-Florida Barge Canal, Relocation of State Road 40	May 1966
Final Summary, Cross-Florida Barge Canal, Restudy Report	February 1977

Flood Plain Information Reports and Special Hazard Information Reports for localities in the St. Johns River Basin are as follows:

Flood Plain Information Reports.

a. Duval County, Lower St. Johns River - March 1969*

b. Orange County, Little Wekiva River - April 1970

c. Seminole County, Little Wekiva River - September 1970

d. Seminole County, Lake Monroe - July 1971

e. Northeast Volusia County - July 1971*

f. Southeast Volusia County - July 1972*

g. Volusia and Lake Counties, St. Johns River and Lake Beresford - September 1974

h. Northwest Putnam and Southwest Clay Counties - September 1975

Special Flood Hazard Information Reports.

a. Econlockhatchee River - June 1970*

b. Hogans Creek, Jacksonville - July 1971

c. City of Hastings - February 1972

d. Howell Creek Basin - March 1974

e. St. Johns River, Brevard County - March 1976

*Not Available

Other Corps of Engineers Studies

An economic restudy of the Cross-Florida Barge Canal has been authorized by the House Appropriations Committee in its report on the 1982 Supplemental Appropriations Act. This restudy is to include previously excluded elements necessary to portray an accurate benefits-to-cost ratio.

St. Johns River, Jacksonville to Lake Harney. A resolution by the Committee on Public Works and Transportation of the House of Representatives on 8 August 1984 has authorized a study of the St. Johns River. This study would determine whether modifications are advisable at this time in the interest of improving channels, removing navigational hazards, stabilizing the shoreline, resolving recreational-commercial channel-use conflicts along the waterways, investigating dredged material deposition areas to improve vector control measures, reducing water runoff and infiltration impacts, and improving the utilization potential of these sites for fish and wildlife and other purposes. At the present time, no funds are available for this study.

Currently under review is the General Design Memorandum (GDM), Central and Southern Florida Project Part 3, Supplement 2, Addendum 3, for the Upper St. Johns River Basin. This GDM contains hydraulic criteria supporting recommendations relative to the construction of necessary water-control works and an environmental impact statement.

The GDM for Jacksonville Harbor-Mill Cove is presently in preparation and scheduled for completion in fiscal year 1985. Improvements to Mill Cove will include flow and circulation features of the recommended plan.

Other Federal Studies

The Federal Emergency Management Agency (FEMA) has produced Flood Hazard Boundary, Floodway and Flood Insurance Rate Maps for communities participating in the National Flood Insurance Program. Communities with detailed Flood Insurance Rate Maps include 100-year and 500-year base flood elevations and area delineations; 10-year flood elevations can be interpreted from information provided. In this program, each participating municipality or county is considered a community. Table 7 contains a listing of communities within the St. Johns River Basin participating in this FEMA program as of 15 July 1984.

The U.S. Department of Agriculture completed a comprehensive study of the river basin in 1969. This study points out the need for a comprehensive plan for agricultural, industrial, and urban land and water resource users in the basin. Land uses were projected into the future so that water-use projections could also be made. Currently, agriculture faces problems of relocation and expansion to satisfy production needs in an environment of growing competition for resource use.

Local Studies

Numerous topical studies have been conducted over the years in the St. Johns River Basin. The St. Johns River Water Management District, since its creation by the Water Resources Act of 1972, has undertaken, and continues to conduct studies on the basin's water quality and water supply conditions and problems. A water use survey is published annually by the SJRWMD. The District also publishes an annual report for each water year which lists their technical reports, memorandums, and circulars for that period. In 1977, a Water Resource Management Plan (Phase I) was adopted by the SJRWMD.

The State of Florida Game and Fresh Water Fish Commission conducted a study of the fishery resources in the St. Johns River. This study covered the period 1976-1981 and was known as the Dingell-Johnson Project. The purpose of the study was to collect and correlate biological and limnological

TABLE 7

PARTICIPATING COMMUNITIES
NATIONAL FLOOD INSURANCE PROGRAM

Community Number	Community Name	Date of Entry	Date of Current Effective Map
120001	Alachua County - unincorporated areas	29 Aug 1973	
120290	Altamonte Springs, City of - Seminole County	18 Mar 1980	18 Mar 1980
120180	Apopka, City of - Orange County	29 Sep 1978	23 Oct 1981
120075	Atlantic Beach, City of - Duval County	15 Mar 1977	15 Mar 1977
120181B	Belle Isle, City of - Orange County	15 Sep 1978	15 Sep 1978
125092	Brevard County - unincorporated areas	22 Sep 1972	16 Sep 1982
120086	Bunnell, Town of - Flagler County	26 Mar 1979	11 Jul 1975
120291	Casselberry, City of - Seminole County	2 Jul 1980	2 Jul 1980
120064	Clay County - unincorporated areas	2 Jul 1981	1 Aug 1983
120020	Cocoa, City of - Brevard County	28 Sep 1979	28 Sep 1979
120408	Crescent City, City of - Putnam County	18 Dec 1979	18 Dec 1979
120307	Deland, City of - Volusia County	22 Dec 1980	NSFHA*
120182	Eatonville, Town of - Orange County	1 Dec 1978	1 Dec 1978
120085A	Flagler County - unincoporated areas	17 Sep 1975	25 Feb 1977
120065	Green Cove Springs, City of - Clay County	1 Mar 1979	26 Mar 1982
120266	Haines City, City of - Polk County	16 Sep 1981	16 Sep 1981
120282	Hastings, Town of - St. Johns County	2 Jul 1981	2 Jul 1981
120078B	Jacksonville Beach, City of - Duval County	15 Mar 1977	15 Mar 1977
120077	Jacksonville, City of - Duval County	1 Dec 1977	15 Dec 1983
120416	Lake Mary, City of - Seminole County	18 Mar 1980	18 Mar 1980
120292	Longwood, City of - Seminole County	18 Mar 1980	18 Mar 1980
120184	Maitland, City of - Orange County	5 Sep 1979	5 Sep 1979
120185	Ocoee, City of - Orange County	1 Nov 1978	1 Nov 1978
120179	Orange County - unincorporated areas	1 Dec 1981	15 June 1984

TABLE 7 (continued)

PARTICIPATING COMMUNITIES
NATIONAL FLOOD INSURANCE PROGRAM

Community Number	Community Name	Date of Entry	Date of Current Effective Map
120066	Orange Park, Town of - Clay County	18 Mar 1980	18 Mar 1980
120186	Orlando, City of - Orange County	3 Sep 1980	26 Mar 1982
120189	Osceola County - unincorporated areas	3 Feb 1982	3 Feb 1982
120293	Oviedo, City of - Seminole County	28 Sep 1979	28 Sep 1979
120273	Palatka, City of - Putnam County	4 Jun 1980	4 Jun 1980
120418	Pomona Park, Town of - Putnam County	4 Dec 1979	4 Dec 1979
120027	Rockledge, City of - Brevard County	15 Nov 1979	15 Nov 1979
125152A	Titusville, City of - Brevard County	16 Jun 1972	30 Apr 1976
120188	Winter Park, City of - Orange County	15 Nov 1979	4 Feb 1983
120295	Winter Springs, City of - Seminole County	16 Sep 1981	15 Jan 1982

*NSFHA - No Special Flood Hazard Area (Non-Flood Prone Community)

information as it related to the sport fishery resource and its management. In the upper river, water quantity was found to have a critical effect on fish populations - dewatering of the headwaters marsh has destroyed much of the natural forage base. Water quality had a greater effect on the biota of the lower river than water quantity.

A classical study of fishes on the St. Johns River was completed by William McLane in 1955 in partial fulfillment of his doctoral dissertation at the University of Florida. He investigated the fishes of the area over a 10-year period. Breeding habits, life history, food and feeding habits, abundance and habitat requirements are discussed for the different species of fish.

Each year the Florida Department of Environmental Regulation produces a study on water quality for the river basin in response to the Clean Water Act. Regional planning councils, such as the East Central Florida Regional Planning Council, have produced studies within the basin as development occurs.

COST SHARING

Any continuation of this study would be as a feasibility phase Survey Review investigation. Under current Administration policy, such investigations are to be undertaken with consideration for 50 percent cost sharing by the local sponsor. This guidance also has established that such cost sharing would contain provisions for 50 percent of the local share to be a cash contribution to the Federal effort; the other 50 percent may be in the form of in-kind services.

COORDINATION REQUIREMENTS

A number of State of Florida and Federal agencies currently have responsibilities with regard to water quality conditions in the St. Johns River Basin. Continuation of this investigation would require extensive technical coordination efforts to successfully conduct environmental assessments that would reasonably establish existing water quality conditions of the waterways in the St. Johns River system.

BASE AND WITHOUT CONDITIONS

INTRODUCTION

This report section presents summary information on general cultural and natural conditions in the St. Johns River Basin. Emphasis has been given to pertinent information essential to the general determination of conditions influencing water quality on the St. Johns River.

POPULATION

From estimates developed by the St. Johns River Water Management District, about 1,720,000 people lived within the surface watersheds of the St. Johns River Basin in 1980. This population represented about 75 percent of the population within the District and about 17.6 percent of Florida's 1980 population. The percentage distribution of 1980 population by major subbasins within the St. Johns River Basin appear below:

St. Johns River Subbasins	Percentage of 1980 Population
Lower Basin	38.9
Middle Basin	29.9
Upper Basin	12.4
Oklawaha Basin	18.8

Population projections to the year 2010 prepared by the Water Management District are presented in table 8. These data project an approximately 64 percent increase in total basin population between 1980 and 2010. Based upon the District's estimates, the counties within the basin with the largest growth potential are Brevard, Orange, Seminole, Volusia, and Duval.

TABLE 8

1980 AND PROJECTED POPULATIONS BY SURFACE WATER SUBBASIN, ST. JOHNS RIVER BASIN

	1980	1990	2000	2010
Lower St. Johns River	667,941	831,904	979,543	1,098,694
Middle St. Johns River	513,464	639,664	753,186	844,803
Upper St. Johns River	212,915	265,393	312,492	350,504
Oklawaha River	323,056	402,058	473,412	530,999
St. Johns River Basin	1,717,376	2,139,019	1,518,633	2,735,000

Source: St. Johns River Water Management District

Large urban and high growth areas significantly influence water quality in the St. Johns River in two basic manners. Large populations with their associated economic activities represent large consumptive use of water, much of which is not returned to a watershed's hydrological system. These losses are factors in trends reflected in decreasing groundwater tables and decreasing local area surface water runoff as area urbanization increases. At the same time, discrete stormwater discharges from urban areas become more intensive due to increased urban storm drainage systems that permit the rapid transport of materials from urban watersheds. These discharges, along with water treatment plant effluents, result in trends towards increasing loads of pollutants moving into tributaries of the St. Johns River from highly developed and rapidly expanding urban areas.

Major growth is occurring in the Orlando Metropolitan Area, with urbanization expanding into parts of Orange, Osceola, and Seminole Counties. Rainfall across this region provides groundwater recharge of the Floridan and shallow aquifers and surface water to tributary streams of the Upper and Middle St. Johns River. In north-central Florida, Ocala in Marion County and Gainesville in Alachua County are also expected to show substantial growth in coming decades. These counties also provide significant recharge to groundwater aquifers and are source areas for major surface water tributaries to the Middle St. Johns River. As urban and industrial growth continues in these major ground and surface water source areas, the need to develop a comprehensive program to protect the availability and quality of these supplies becomes more critical. Throughout much of the St. Johns River Basin, the Floridan aquifer is the primary source of potable water.

In the Lower St. Johns River Basin, Jacksonville depends almost entirely upon this deep aquifer for its potable water supplies. Jacksonville's economy is based upon a broad spectrum of industrial and commercial activities that have been undergoing rapid expansion since about 1980. This area of formerly slower growth apparently now can expect major economic and population expansion through the forseeable future. Included with this ongoing growth are major expansions in commodity handling capabilities and increased deep-draft shipping activities at the Port of Jacksonville along the St. Johns River. Within metropolitan Jacksonville, the St. Johns River system is also a major recreation attraction. The river system is used for a wide variety of active and passive recreational activities, and improvements in the region's tributary stream water quality would provide for increased public safety as recreational uses of the river increase. Similarly, recreational activities are also significant and expanding throughout the entire St. Johns River system.

The expanding metropolitan uses of the Lower St. Johns River are placing stresses upon the estuarine ecosystem throughout Duval County. The broad ecological significance of the the St. Johns River estuary was described in the Metropolitan Jacksonville Water Resources Study (See Prior Studies and Reports Section). The river and associated estuarine environment are used as spawning areas and primary nursery grounds for numerous species of finfish and shellfish taken by recreational and commercial fishermen from the river and from adjacent Atlantic Ocean coastal waters. This estuary is the southernmost of the major North American fish breeding and nursery grounds on the Atlantic coast. Continued deterioration of the river system for use as a nursery and breeding ground can be expected to affect fisheries along extended areas of Florida's Atlantic coast.

AGRICULTURAL LAND USES

Throughout the basin, agricultural production places major demands upon available water resources. Agriculture and forestry activities are essential elements of Florida's economic base, but these activities also have brought about major changes in hydrological regimes and surface water runoff within watersheds tributary to the St. Johns River and within the flood plain of the river. With the changes in watershed hydrological characteristics, these practices also have been responsible for changes in water runoff characteristics from areas improved for these uses.

Information on current agricultural land uses within the St. Johns River Basin were not available for this report. A 1965 U.S. Department of Agriculture St. Johns River Basin Investigation provided the most useful basin-level information. The 1965 study included all of the St. Johns River Basin and coastal lands and waters for coastal counties. These data over estimate the agricultural-related land uses within the basin but provide generally useful information on relative uses of agricultural lands. From projected information presented on table 9 for 1980, about 10.7 percent of the region was in citrus, vegetables, and other crops; 23.1 percent was in improved and unimproved pastures; 58.8 percent was in forest land; and 7.5 percent was in miscellaneous use.

TABLE 9

MAJOR AGRICULTURAL USES OF LAND WITHIN THE
ST. JOHNS RIVER BASIN

1965 AND PROJECTED
(ACRES)

	1965	1980	2000	2020
Citrus	357,200	400,800	459,600	546,400
Vegetables[1]	68,700	86,200	91,600	97,200
Other Crops	107,500	103,200	115,000	129,000
Improved Pasture	634,700	789,500	920,200	1,084,100
Unimproved Pasture	707,200	492,300	242,700	69,700
Forest Land	3,514,500	3,260,200	3,043,800	2,772,600
Miscellaneous Uses	515,800	415,700	333,300	271,000
Total	5,905,600	5,547,900	5,206,200	4,970,000

1 Includes potatoes and melons

Source: Report for St. Johns River Basin and Intervening Coastal Areas, Florida, U.S. Department of Agriculture, 1969, pages 4-6.

The available agriculture data indicate that over the 1965-2020 timeframe, citrus, vegetables, and other crop lands were expected to increase. Overall lands devoted to pasture were projected to increase with significant declines in unimproved pasture land, forest land, and miscellaneous lands.

Substantial agricultural land-use changes have been observed in parts of the basin in recent years. Detailed information is clearly needed to determine points of probable agricultural land-use pollutant runoff from sub-watersheds of tributary streams to the St. Johns River. Agriculture also represents consumptive use of water. Irrigation practices can be expected to increase as intensive agricultural activities (citrus and vegetables) expand in the basin.

In Central Florida highland recharge areas, the Floridan aquifer can be easily contaminated due to its close proximity to agricultural pollution sources. In areas where irrigation water from the Floridan aquifer is a major source of recharge to the unconfined aquifer, fertilizer and pesticide concentrations in the unconfined aquifer can be expected to increase. High concentrations of nitrates and phosphates in the nonartesian aquifer have also been measured in some of these areas, possibly due to the leaching of agricultural fertilizer.

With myriads of canals and improved watercourses constructed during the past century of development in the basin to lower groundwater tables and to prevent flooding of agricultural and urban lands, much of the natural area nutrient control mechanisms have been eliminated or made ineffectual. In watershed uplands, much of these natural nutrient storage areas have been eliminated, and nutrient rich runoff moves quickly through improved watercourses to tributaries and the St. Johns River. Continuing development within the basin can be expected to compound this recognized problem. The ability of tributary streams and the St. Johns River to effectively assimilate these materials is presently unknown, but water degradation and nuisance conditions are apparent in water bodies and numerous streams tributary to the St. Johns River. These conditions have been widely considered to have hindered the utilization of the St. Johns River for recreational purposes and have been associated with the decline in the fish and wildlife resources of the Upper Basin.

With increasing demands for water as the basin's population and economic activities increase, the need for an integrated water resource management program has become a major State of Florida concern. The State and local governments within the basin now generally recognize the need to participate in the development of a more comphrensive approach to the protection of the basin's water resources.

CLIMATIC FACTORS

General

Florida's climate is characterized by moderate to high temperatures, low daily and seasonal temperature variations, and relatively high annual precipitations and humidity. The St. Johns River Basin is located within the transition zone between the subtropical climate of South Florida and the humid, continental climate associated with the remainder of the Southeastern United States.

Temperature

The study area has generally mild temperatures. Daily summer maximums and minimums average about 90 °F and 72 °F, respectively. Prolonged summer temperatures exceeding 98 °F rarely occur. In the southern part of the basin, temperatures above 90 °F can occur in any month of the year.

During the winter, cold waves associated with frontal activity can cause temperatures to fall below freezing throughout the basin. However, cold waves with hard freezes are usually of short duration. Freezing temperatures normally occur at night and during the early morning hours with winter midday temperatures usually rising well above the freezing point even under the continued dominance of a cold air mass. Freezing temperatures may begin as early as November in the northern part of the St. Johns River Basin but only occur occasionally during each winter season in the extreme southern headwater areas of the basin.

Rainfall

Most of the basin's annual precipitation occurs during the months of June through September. Short duration, high intensity rainfalls usually associated with thunderstorms account for the majority of summer precipitation.

Improved information recently developed by the National Oceanic and Atmospheric Administration (NOAA) indicates that the so-called summer air mass showers and thunderstorms are not major sources of rainfall in Florida. Much of peninsular Florida's summer showers and thunderstorms are associated with larger or mesoscale systems that move across the state. These large systems may or may not be supported by other recognizable contributing air disturbances known to provide summer rainfall in Florida. Contributory influences include: cold air aloft, planetary system related tropical and subtropical waves and cyclones, sea and lake breezes, squallines, and penetrations of weak frontal zones.

From data provided by the St. Johns River Water Management District, the basin's mean annual precipitation ranges from 48.99 inches to 59.14 inches for the period 1947-1976. For this period of record, the highest rainfall was 84.95 in/year while the lowest was 27.44 in/year. Plate 6 shows the mean annual rainfall for the St. Johns River Water Management District. Historical data for the Upper Basin indicate that return frequencies of floods and drought have shown average returns every 3-5 years. However, data for the 1965-84 period indicate a higher frequency of less-than-average rainfall.

On rare occasions, in the northern part of the basin, a trace of snowfall may be associated with the passage of winter cold fronts. In the southern basin area, short intense rainfalls exceeding 1 inch per event are common. Thunderstorms occur more frequently in central Florida than in any other portion of the continental United States.

Winds

Mean wind speeds at selected military installations are given in table 10. As fronts and tropical disturbances pass across Central Florida and in the vicinities of thunderstorm activity, wind speeds in excess of 50 mph can be expected. Occasional tornado-like winds also can be expected, often in association with the passage of early spring frontal systems.

Storms

Mesoscale storms, associated with planetary atmospheric conditions apparently bring much of the annual rainfall to the St. Johns River Basin. Several patterns of large-scale atmospheric disturbances are currently apparent. Winter storms, usually of short duration and often with little rainfall, are typically associated with the movement southward of polar air masses. These storms bring typically fast moving fronts from the northwest to the north into the Florida peninsula from the fall through spring seasons and are associated with the occasional major freezes that occur in the state. During the fall and early winter months, the relative orientation of major high and low pressure systems over North America result in 3 to 4-day storms, called "northeasters," along Florida's Atlantic coast. These storms are marked by persistent 20-30 mile per hour winds from the north to northeast

TABLE 10

SURFACE WINDS AT SELECT MILITARY INSTALLATIONS
IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

	Cape Kennedy AFB 1951-52, 1957-70		Jacksonville NAS 1945-70		McCoy AFB, Orlando 1944-45, 1952-67	
Month	Dominant Quadrant	Mean Wind Speed (knots)	Dominant Quadrant	Mean Wind Speed (knots)	Dominant Quadrant	Mean Wind Speed (knots)
January	NW	8.5	NE	7.2	NE	6.6
February	NW	9.0	SW	7.5	NE	7.1
March	SE	7.4	SW	7.7	SW	8.2
April	SE	8.6	SE	7.3	SE	8.0
May	SE	8.3	SE	7.3	SE	7.0
June	SE	7.6	SE	7.2	SE	6.6
July	SE	7.2	SW	6.1	SW	5.4
August	SE	6.6	SW	5.8	SE	5.1
September	SE	7.6	NE	8.7	NE	6.0
October	NE	9.5	NE	8.6	NE	6.9
November	NW	7.7	NE	7.6	NE	6.8
December	NW	7.8	NE	7.3	NE	6.7
Prevailing Wind Direction	SE		NE		NE	

1 Knot = 1.689 feet per second

Source: Water Resource Management Plan, Phase I, St. Johns River Water Management District, Palatka, Florida, November 1977.

and light rainfall. During these storms, high tides along the Atlantic coast reduce discharges from the St. Johns River, result in increased water levels throughout the Lower Basin, and produce higher than normal tidal effects throughout the Lower and Middle Basins. Sometimes, the relative alignment of high and low pressure systems to the north of Florida also result in the northerly movement of warm Gulf of Mexico air from the south and southwest across the Florida peninsula. These conditions usually occur a few times each year, also typically during the fall and early winter months. Rainfall on the St. Johns River Basin may be associated with these systems, but wind related tide reductions along the Atlantic coast can result in increased discharges from the St. Johns River during their occurrences.

During the spring, summer, and fall seasons, the Florida peninsula comes under the influence of the planetary wind belt known as the "prevailing easterly" winds. This planetary system apparently contributes to much of the intense summer rainfall occurrences across the peninsula. The National Oceanic and Atmospheric Administration has recorded the more apparent astmospheric disturbances associated with this system. The most intense is a hurricane, so named when persistent wind speeds exceed 74 mph. When wind speeds of these storms are between 38 mph and 73 mph, they are called tropical storms. While hurricane and tropical storms are well recognized in Florida, substantial summer rainfall across the peninsula occurs as a result of the more frequent but largely unrecognized easterly atmospheric disturbances variously named as tropical low pressure systems, tropical depressions, or tropical waves. These and other largely unrecognized mesoscale atmospheric disturbances apparently are often associated with the summer movement of heavy rainfall producing thunderstorms across the St. Johns River Basin.

Weather and Climate Impacts on Basin Water Quality

Florida's rainfall is highly variable, and this variability greatly influences surface water discharges from land surfaces and from tributary streams to the St. Johns River. The variability is generally predictable on a seasonal basis; heaviest rainfall and the greater total rainfall occurs during the summer and early fall months. However, great variability in the day-by-day distribution of this rainfall also occurs. It is common, even during summer months, for rainfall stations to record rainfall for 10 or fewer days during a single month. Other months and in other years, summer rainfall at that same station may occur for the majority of days in a month. Usually with passage of a tropical or planetary system related atmospheric disturbance, heavy, sometimes very intense, rainfalls and lines of rain squalls with thunderstorms deposit rainfall on the basin. Depending on the storm's track, such rainfall, that has been known to exceed 12 inches in a 24-hour period, will occur with heaviest concentrations distributed randomly on watersheds within the basin. On rare occasions, easterly disturbances and major tropical storms have followed tracks from south to north the entire length of the basin. As a result of intense rainfall, runoff from land areas of affected watersheds will carry heavy concentrations of materials (litter, detritus, humus, inorganics, etc.) into tributary streams and the St. Johns River.

As river flows from such rainfalls increase, stream velocities permit the resuspension of bottom sediments. Under these conditions swamps, marshes, and lakes within the system that function as nutrient sinks during low-flow, and normal-flow conditions can be expected to have dissolved and suspended materials removed and transported further downstream or to the Atlantic Ocean.

The passage of the prevailing easterly winds across the southern Florida peninsula during much of the year and polar frontal winds from the north and west during winter months also carry and deposit quantities of particulate matter across Florida. Since 1965, records of deposition of dust particles from Africa on the Florida peninsula have been obtained, and the chemical constituents of these materials are now under study. The U.S. Geological Survey has developed some general information on the chemical constituents of particulate material deposited by winds on selected areas of Florida. These data indicated that Florida rainfall pH ranged between 4.4 and 8.8; total nitrogen, between 0.5 and 2.4 mg/l; and total phosphorus, between .03 and .30 mg/l. Recent studies conducted on Lake Okeechobee indicate that 16.7 percent of the phosphate deposited upon the lake comes from rainfall and atmospherically transported particulate material. Similar widespread wind and rainfall related depositions of material can be expected to occur across watersheds in the St. Johns River Basin, and large quantities of organic and inorganic particulate material carried into the basin by winds and rainfall would become part of runoff from land.

GEOLOGY, SOILS, AND LANDFORMS

General

The Florida peninsula is the partially emerged portion of a large plateau that extends from the main mass of the North American Continent. The Florida peninsula and adjacent continental shelves are considered to have been tectonically stable throughout the Mesozoic and Cenozoic Eras. Moreover, the peninsula is one of the most seismically stable areas in the United States.

There are five basic types of rock material at or below the surface within the study area boundaries: anhydrite, limestone, dolomite, clay, and quartz sand. Dolomite is a chemical variation of limestone and is usually harder. Anhydrite is a very hard rock that forms mainly by evaportation of large stagnant basins of sea water. Various layers (beds) are grouped into geologic formations which are characterized by generally the same type of rock over fairly large areas.

The Cedar Keys Formation consists of dolomite and anhydrite. The formation is rather thick, up to 1,300 feet. The Cedar Keys Formation contains mainly salt water in most areas. Some deep waste-injection wells penetrate this formation.

The Oldsmar limestone consists of dolomite and limestone. Like the Cedar Keys Formation, the Oldsmar limestone is rather thick, exceeding 1,000 feet. Along the coast and in the southern portion of the study area, the Oldsmar limestones contain salt water. In other regions, such as in the Jacksonville area, fresh water can be obtained, although not many wells exist to the necessary depth.

The Lake City limestone consists of dolomite and limestone and averages about 400-500 feet in thickness. Water obtained from this formation is generally good quality if no salt water intrusion has occurred.

The Avon Park limestone also consists of dolomite and limestone. In some areas, the formation is almost completely dolomite. Generally, this formation is relatively thin, less than 250 feet. In Jacksonville, for instance, the average thickness is 50 feet or less. At the southern end of the study area in Indian River County and parts of Brevard County, the Avon Park limestone thickens to over 300 feet. Over most of the study area, water obtained from this formation is potable. Exceptions are along the coast and in areas of saltwater intrusion, such as the East Palatka area and some other areas along the St. Johns River.

The Ocala Group consists mainly of soft limestone and varies considerably in thickness from less than 60 feet to over 500 feet at Fernandina Beach. Near Deland, Eustis, and Clermont, the Ocala Group is entirely absent. Almost all deep water wells withdraw at least a part of their supply from the Ocala Group limestone. Where the Ocala is absent, deep wells obtain their water from the Avon Park limestone.

The Suwannee limestone, which consists of limestone and limestone with clay and sand, exists within the study area only along the eastern half of the Indian River County. Maximum thickness is 200 feet.

The Hawthorn Formation is primarily clay, limestone, and phosphatic material. This is the principal confining layer that covers the Floridan aquifer in much of the basin. The Hawthorn Formation confining deposits cause the Floridan aquifer to take on artesian characteristics at lower elevations through much of the basin. Throughout the entire St. Johns River valley, the Floridan aquifer's potentiometric surface rises above land surfaces permitting surface discharge from wells penetrating into the aquifer (plate 7). This phenomenon has resulted in numerous localities within the basin where deep aquifer waters emerge as springs and extensive seepage discharge areas. By 1976, 51 springs had been identified in the St. Johns River Basin. Among these is Silver Springs, considered to be Florida's largest freshwater spring. Spring discharges mainly influence water conditions in the Middle St. Johns River Basin. Alachua County is known to have 6 springs; Clay County, 5; Lake County, 8; Marion County, 9; Orange County, 6; Putnam County, 7; Seminole County, 8; and Volusia County, 5. In some areas of the river basin such as in most of Volusia County, some of Lake and Marion Counties, and north Brevard County, the formation is absent. Beds of limestone or sand within the formation sometimes yield small to medium quantities of water to wells. These beds are considered the secondary artesian aquifer. Thickness of the Hawthorn varies from being absent in parts of Volusia County to over 500 feet in the extreme northern portion of the study area.

The Tamiami Formation consists of coquina (a cemented or loose mixture of crushed and ground shell fragments), clay, and sand. Like the Suwannee limestone, the Tamiami exists only in Indian River County.

Covering all rock units over most of the study area is a relatively thin blanket of sand and clay. Maximum thickness of this blanket occurs in the Central Highlands where the sand is as much as 150 feet thick.

Structure

The geologic structural influence on the St. Johns River indicates that faults and fault zones apparently occur over a significant portion of the river (plate 8). Faulting and other movements associated with the Ocala uplift are considered to have played an important role in determining the course of the St. Johns River.

The age of the fault in Duval County is unknown, but it is younger than the Crystal River Formation, which is offset by the fault, and is probably older than the Hawthorn Formation, which does not appear to be offset. The upthrow side in Duval County is to the west. The resultant vertical displacement has affected the depth of the top of the Floridan aquifer, with the result that the top of the aquifer is about 50 to 150 feet closer to the surface on the west side than on the east side. This fault is no longer active. It has not been active in historical times and most likely not for a considerable time before that.

The St. Johns River follows the alignment of the fault from Lake George to just south of Palatka, where it breaks to the east to re-enter the eastern valley.

An apparent extensive anomalic depression in eastern Orange and northeastern Osceola Counties is also considered to be a fault zone. It apparently extends from a point in the vicinity of Lake Helen Blazes to a point along the easterly side of Lake Harney. The impacts of this fault zone upon the hydraulic characteristic of the Floridan aquifer within the Upper St. Johns River project area remain to be determined.

Soils

The soils in the basin range from deep, excessively drained sandy soils on the ridges to very poorly drained acidic, peat and muck soils in marshes and swamps. Others have clean silica sand horizons extending to great depths. Many are strongly affected by ground water that fluctuates near the surface.

The four broad groupings of soils in the basin based on drainage characteristics, are: (1) sandy, droughty soils not subject to flooding; (2) well-drained soils not subject to flooding; (3) moderately well to poorly-drained soils not subject to flooding; and (4) poorly and very poorly drained soils subject to flooding. The droughty soils are thick sandy soils and thick sand soils with loamy subsoils with rapid soil percolation. During periods of maximum precipitation, the water table fluctuates from 30 to more than 60 inches below the ground surface. The well-drained soils are characterized by very thick sands with loamy or clayey subsoils. The moderately well to poorly-drained soils are generally sands with loamy or clayey subsoils or with weakly cemented sandy subsoils. The poorly and very poorly-drained soils range from sands with loamy subsoils to soils with organic layers greater than 50 inches thick.

Deposits of marine sediments are fairly thick in areas around Lake Jessup and in an extensive belt along the St. Johns, Wekiva, and Econlockhatchee Rivers. Most of the soils in Seminole County were formed in these acid, sandy, marine-terrace deposits, and they in turn are acidic and sandy.

The Upper St. Johns River Valley is the second largest region of peat deposits in Florida. The largest and purest deposits of peat are east, north, and southeast of Blue Cypress Lake in marshes where surface water generally flows northward forming the headwaters of the St. Johns River. Large quantities of peat are found south of Lake Helen Blazes. Most of the material around Lakes Poinsett, Winder, Washington, Sawgrass, and Helen Blazes is muck rather than peat. A peat deposit south of Palatka, on the St. Johns River, was once used but now most of the marsh and swamp areas at this location contain muck rather than peat. Marion and Seminole Counties have a number of large peat areas in the Oklawaha River Valley and near Lake Jessup. Duval County had two areas containing peat, one on Julington Creek and the other on Pablo Creek, that proved to be uneconomical for further development due to drainage problems.

Peats and mucks form in marshes and swamps under oxygen deficient or anoxic water substrate conditions where facultative and anaerobic bacteria perform decomposition functions. Anaerobic bacteria are unable to completely transform organic fractions of vegetation litter deposited in surface waters of these areas. Aerobic bacteria may function on surface waters of swamps and marshes where high nutrient water conditions promote extensive biological productivity. Aerobic processes in these areas continue to function as long as water inflows occur from rainfall, seepage, or surface runoff. When these conditions cease, the entire water columns of these areas can become deoxygenated or anoxic. Peat and muck buildup in these areas are only known to occur under anoxic water conditions. Under normal conditions, as decomposing vegetative materials settle in the water column, biochemical activity at lower water levels consumes available oxygen in the water resulting in oxygen deficient water conditions at and below the bottom or substrate. These conditions result in incomplete carbonaceous material conversion; the accumulation of carbons as peat and muck; and the production of fats and oils, methanes, hydrogen sulfide, and other associated compounds.

Landforms

The basin consists of low, nearly level plains to gently rolling hills; numerous intermittent ponds, swamps, and marshes; many lakes, and a few perennial streams. Elevations range from sea level along the coast to approximately 310 feet above mean sea level in Lake County. Some central highlands areas are characterized by many ridges and depressions without any well-defined system of surface streams or outlets (plate 9). The largest of these areas within the basin is about 523,000 acres in size and extends from near Gainesville to south of Ocala along Florida's Central Highlands and the basin's western boundary. These areas are usually lacking features of the Hawthorn Formation and are considered as important sources of recharge for the groundwater supply.

The lakes that make up part of the St. Johns River are considered to be remnants of a once continuous body of standing water which has been gradually filled in by sediment and vegetal accumulation in the reaches between the lakes. These lakes have a distinctive shape - every one is elongated in the direction the river flows through it. This is in contrast to the lakes farther inland which appear in clusters rather than in a linear fashion.

NATURAL RESOURCES

Vegetation

The natural vegetation of the St. Johns River Basin has been drastically altered by man's activities since settlement of the area began following Florida's incorporation into the Nation in 1821. With continuing development, progressive changes in remaining natural vegetation areas can be expected. With these changes, the basin's soil characteristics, surface water drainage, detention and infiltration of water into the water table aquifers, and changes in the quality of surface and ground waters should be expected. While man's actions have resulted in major land cover changes, the area's climate, topography, and soils still generally dictate the character and potential distribution of vegetation.

Topography, soils, and drainage conditions are closely correlated with existing vegetation associations. However, the water table level, or soil wetness, is the most significant factor governing the location and dominance of species in general vegetation communities. Throughout the basin, mid-level areas or flatwoods, generally located between low sand ridges and wet depressions, are dominated by pines. The several typical pine species prefer slightly differing soil elevations above water tables. This natural selection process is partly controlled by the degree of somewhat seasonal flooding that occurs on these areas due to their extreme flatness. Massive harvesting, drainage programs, and successive replanting over the years have blurred many of these natural vegetation preference areas.

Within the coastal lowlands, slightly rising sandy ridges have resulted in transition vegetation from wetlands, to flatwoods, to mesic associations, and to xeric communities on the highly permeable sand ridges. Due to the recession of succesive ocean levels since Pliocene times, series of ridges and swales generally parallel the form of the Florida peninsula, with ridges representing Pleistocene coastal dune formations.

Numerous other subtle conditions influence the preference areas for specific vegetation types. For example, the near subtropical climatic conditions of the Upper Basin permit the northward penetration of sawgrass into the marshes of southern Brevard County to the south of Lake Washington. As groundwater salinities increase in the Upper Basin river flood plains to the north of Lake Poinsett, the land is vegetated with fewer species, primarily sand cordgrass, a few scattered cabbage palms, and small cabbage palm hammocks. In the Upper Basin, only a few isolated hardwood swamps occur along main tributary streams. In the Middle and Lower Basins extensive hardwood swamp strands are found along drainageways and along the St. Johns River. The characteristics of these swamps are highly variable, with species types dependent upon adjacent waterway extent, flow characteristics, siltation-turbidity characteristics, and general water quality. Similar variations are found in all vegetation associations in the basin. Within this context of variability, all complexes of vegetation associations found within the basin contribute to soil building processes and to recycling of nutrients in the environment.

Concern for the need to protect such areas has become very apparent in recent years. The St. Johns River Basin has extensive wetland areas. Much of the Upper Basin was a vast marsh land bordered by savannah-like grass lands. Earliest records note the use of these grass lands for cattle grazing by Indians and later by European settlers. Various types of marsh land communities are found along the numerous lakes on the river and on tributary streams. As the St. Johns River becomes more heavily influenced by saline ground water and finally tidally derived sea water, the marsh lands take on characteristics of estuarine ecosystems.

Similarly, swamps are characteristic of isolated depressions, wetter flood plain areas of all tributaries, and long stretches of the main stem of the river. Forest associations within these varieties of swamps also indicate many unique characteristics.

Endangered or Threatened Species

Endangered or threatened species that can be found in the St. Johns River Basin are the manatee (Trichechus manatus), the bald eagle (Haliaeetus leucocephalus), the brown pelican (Pelecanus occidentalis), the dusky seaside sparrow (Ammospiza maritima nigrescens), the wood stork (Mycteria americana), the red-cockaded woodpecker (Picoides (Dendrocopos) borealis), the American alligator (Alligator mississippiensis), and the eastern indigo snake (Drymarchon corais couperi). Two migrant birds are also considered endangered or threatened: the Artic peregrin falcon (Falco peregrinus tundrius) and Kirtland's Warbler (Dendroica kirtlandii). The entire St. Johns River, including Lake George, has been declared critical habitat for the manatee. The critical habitat for the dusky seaside sparrow is located on the eastern side of the St. Johns River between Lakes Harney and Poinsett over to Interstate 95.

NUTRIENT CYCLING THROUGH WETLANDS

Wetlands are generally fragile environments with highly variable and locally unique characteristics. Accordingly, wetlands function very differently from place to place. For riverine or flood plain wetlands, numerous national and international scientific investigations have noted highly variable functions in nutrient cycling with seasonal cycles of nutrient inflow-outflow characteristics trending towards long-term saturation of nutrient assimilations.

Concern for the fragility of freshwater wetlands for wastewater management was recently expressed in the U.S. Environmental Protection Agency Environmental Impact Statement on the use of wetlands for wastewater management (EPA 904/9-83-107). The following general description of wetlands suggests this Federal concern.

> Each wetland is unique in terms of location, morphology and other physical parameters that influence the receipt and deposition of water. Catchment size and morphometry, antecedent moisture, infiltration capacity and climatic fluctuations function as control mechanisms for inundation frequency and duration. The temporal characteristics of inundation determine vegetation distribution, diversity, and flows and regulate filtration processes. Wetlands typically reduce peak flows and regulate filtration processes. Wetlands typically reduce peak discharge and total stormflow volume because short-term detention storage is greater, and overland flow through a wetland frequently occurs as sheetflow.
>
> Storage fluctuations in wetland ecosystems are closely linked to seasonal variations in rainfall, evapotranspiration, water table level and soil moisture. Groundwater is the major component of storage in a wetland basin and recharge and discharge processes depend on whether the wetland is isolated from underlying aquifers.

When dissolved oxygen in water bodies and wetland areas is plentiful, plant and animal proteins and carbohydrates are decomposed by bacteria under aerobic conditions. Under this process, proteins and carbohydrates essentially break down into carbon, carbon dioxide, hydrogen, and nitrogen (primarily in ammonia or ammonium ion forms). The aerobic bacteria then further oxidize the ammonia into nitrites or nitrates which can be used by aquatic plants to form new plant protein.

If re-aeration of the water does not occur and available oxygen is eventually depleted (a typical condition in swamps and other vegetated wetland areas), organic matter decomposition by bacteria occurs by anaerobic processes. Under this condition, facultative and anaerobic bacteria reduce organic compounds to organic (primarily acetic and propionic) acids. Anaerobic bacteria then convert the organic acids to methane and carbon dioxide. Other anaerobic bacteria also reduce the sulphates naturally found in most waters to sulfides and then to hydrogen sulfide. Hydrogen sulfide is readily identified by a sulfurous rotten-egg smell, and wherever this odor is present the anaerobic decomposition process has occurred or is occurring.

Anaerobic decomposition processes are normal conditions of high organic or mucky sediments typically found in many wetland areas. Under warm temperature conditions where hydrogen sulfide gases come into contact with oxygen either in water or at the water-air interface point, a chemical reaction occurs and sulfuric and companion acid compounds can be found. Hydrogen sulfide is quite toxic to fish; and apparently concentrations on the order of 6 mg/l can kill carp in a few hours. A 1947 U.S. Fish and Wildlife special scientific report (No. 39) noted that from natural or set burning of dried Everglades slightly acid soils, some sulfur from vegetation in the muck apparently is converted to sulfides, which is further converted, in part, to hydrogen sulfide from contact with alkaline sulfides in rainfall. The hydrogen sulfide apparently then moves in solution through the porous soils to seepage discharge points.

Dissolved oxygen (DO) values consistently below saturation have been reported for many wetlands in the southeast. Low DO levels in humic swamp waters are attributed to heterotrophic respiration of organic matter, decomposition, and a chemical process of oxygen consumption in the presence of iron. Dissolved oxygen levels affect the release of nutrients, microbial respiration, and organic matter decomposition. Increased organic loadings in wetlands will alter the prevailing DO regime and require the flora and fauna of wetlands to adapt to a larger range of DO.

Wetlands are also typically acidic with pH levels less than 7.0. This low pH, associated with organic acids leached from wetland vegetation significantly impacts the species composition and water chemistry of closed wetland systems. Wetland systems that are well buffered tend to maintain a relatively constant pH; wetland systems that are not well buffered are generally those with high internal sources of acidity and few outside sources of alkalinity.

Nutrient cycling may be the most important yet complex and least understood wetland characteristic. Nutrients (nitrogen, phosphorus, carbon, and sulfur) and the dissolved constituents move through wetlands in association with the hydrologic regime and atmospheric diffusions. The path by which nutrients move through wetlands is altered by long-term uptake, internal cycling, dilution, and diffusion. Nutrient retention or release in a wetland is site-specific and dependent upon litter fall patterns, rate of litter decay, internal chemistry, substrate composition, seasonality, hydrology, and other locally important ecological parameters. The rate of nitrogen, carbon, and sulfur transformations is further modified by bacterial action. An understanding of a specific wetland's nutrient cycling characteristics is essential in order to assess the impacts of increased nutrient loadings.

The geochemical interactions normally occurring in natural environments are difficult to measure. However, these ongoing physical processes occurring in wetlands along the St. Johns River should be expected to contribute significantly to the natural or ambient water quality characteristics of the river.

ST. JOHNS RIVER GENERAL HYDROLOGIC CHARACTERISTICS

Upper Basin

The Upper St. Johns River Basin has its upland headwaters along Fort Drum Creek in northwestern St. Lucie County and northeastern Okeechobee County (Plate 1). These waters flow into a valley marshland that extends throughout Indian River County. This marshland is a remnant of a much larger marshland area that has been converted to agricultural uses. At the Indian River/Brevard County line, an old roadbed, known as the Fellsmere Grade, retards waterflow during normal and low flow conditions permitting the headwaters marshlands to function as a peat and nutrient sink. About 8 miles downstream of the Fellsmere Grade at about mile point 275, the first discernible channel of the St. Johns River becomes apparent. The river then follows an irregular course through a series of lakes to the head of Lake Harney, a short distance downstream of mile point 191. Mile point 191 is used by the Corps of Engineers as the downstream point of the Upper St. Johns River Basin (See Tables 1 and 2).

Lake Helen Blazes forms the first natural surface water storage area along the river channel. The lake flood plain below 16 feet N.G.V.D., including the lake, extends for an east-west distance of about 1 mile. Average bottom low points of 9.7 feet N.G.V.D. were surveyed in this lake in 1954. The riverbed at the north end of the lake was surveyed at 10.0 feet N.G.V.D. Average flood plain elevations of 16.0 feet N.G.V.D. extended almost 2 miles to the east and west of the lake mouth. At low to moderate stages the streamflow from the Florida turnpike, at mile point 304, to Lake Helen Blazes is conveyed northward by a complex system of borrow canals. At higher stages, the northward conveyance is mainly sheetflow until the St. Johns River channel is reached at about mile point 275.

In the vicinity of river mile point 268, Jane Green Creek discharges into the river flood plain marshlands. The stream receives discharge from an approximately 248-square-mile watershed with headwaters areas on the Osceola Plain. Jane Green Creek is essentially an 8-mile-long discharge channel for its major tributaries, Bull Creek and Crabgrass Creek. A USGS gaging station (Jane Green Creek near Deer Park, Florida) is located about 2 miles downstream of confluence with these tributary streams. The 12-year record period (October 1953 to September 1965) indicated a highly variable flow from this system. Mean discharge for that period was 311 cfs, but a maximum station discharge of 18,400 cfs was recorded for 17 October 1956, and no flow was recorded for many days in some years. Based upon duration table data of daily discharges for this period, less than 238 cfs of flow was recorded at this station 50 percent of the time. USGS 1982 data indicated an average discharge of 244 cfs at this gage for the 1953-1982 period with no discharges exceeding the recorded 1956 maximum. In the vicinity of the mouth of Jane Green Creek, 1954 survey data placed the St. Johns River bed at 9.8 feet N.G.V.D. about .5 mile south of Little Sawgrass Lake. An average flood plain elevation of about 16 feet N.G.V.D. was recorded for the valley marsh lands in the vicinity of Jane Green Creek discharge localities.

Little Sawgrass Lake and Sawgrass Lake, with a combined estimated surface area of .7 square mile and 1954 bottom elevations of 9.6 feet and 8.3 feet N.G.V.D., respectively, are minor river-run surface water storage areas. The flood plain in the vicinity of these bodies has been constricted to roughly 1.5 miles by a private farm dike on the west and the Melbourne-Tillman Drainage District levee on the east.

The first USGS stream gage on the main channel of the Upper St. Johns River is located on the upstream side of the U.S. Highway 192 bridge (State Road 500) at river mile point 262.0. This stream measures drainage from the uppermost 968+ square miles of the Upper St. Johns River Basin, including downstream flow through the Fellsmere Grade and the 248-square-mile Jane Green Creek watershed. An average discharge of 762 cfs was recorded at this gage for the period October 1939 to September 1965. USGS data for the 43-year record period through 1982 indicated an average discharge of 675 cfs. A maximum daily discharge of 18,000 cfs was recorded at this gage on 18 October 1956. Wind effect reverse flows occur occasionally at this station during droughts, with a maximum reverse flow recorded in 1950. The minimum water surface elevation of 9.94 feet N.G.V.D. was recorded during a drought on 27 May 1975. During the 1956 drought, a record 107 days of no downstream discharge occurred. However, during the initial 26-year period of record (1939-1965), flow past this gage exceeded 328 cfs, 50 percent of the time. USGS analysis of annual low flow conditions for the period July 1940 to June 1977 indicated flows at this gage of 92 cfs or below for at least 90 consecutive days had 2-year recurrence intervals; flows of less than 84 cfs for at least 183 consecutive days had 5-year recurrence intervals; and flows of less than 44 cfs for at least 183 consecutive days had recurrence intervals of 10 years. Zero flow for at least 30 consecutive days had a 10-year recurrence interval. These data suggest that the St. Johns River upstream of this gage seasonally has had long periods with little or no flow since gaging began in 1939. Continuous land-use changes in watershed headwater areas can be expected to alter characteristic St. Johns River probable flow conditions through the foreseeable future.

Downstream of U.S. Highway 192 (State Road 500), Lake Washington forms a 4.1-mile-long river-run depression and functions as a surface water storage area and temporary nutrient/sediment sink. The lake discharges to the river at mile point 257.9. The surface area of the lake is 6.7 square miles. Survey data from 1954 showed sediment accumulation in the southerly 25 percent of the lake with low point bottom elevations at 7.9 feet N.G.V.D. Near its mouth, low point bottom elevations of 6.1 feet were recorded. Flood plain land elevations adjacent to the lake occur below 16 feet N.G.V.D. for a distance of about 2 miles to the east and over 4 miles to the west. However, farm dikes generally parallel the lake approximately 1 mile to the west. The lake has great significance for the 90,000+ people living in South Brevard County who use it as their source of potable water.

Lake Washington elevation records for the period July 1942 to October 1979 indicated a normal fluctuation between a mean annual low elevation of 13.28 feet N.G.V.D. and a mean annual high elevation of 17.48 feet N.G.V.D. A maximum daily elevation of 20.39 feet N.G.V.D. occurred on 1 October 1960, and a minimum daily elevation of 9.88 feet N.G.V.D. was recorded on 28 May 1975. The drought of 1956 caused lake elevations to fall to a record mean daily low of 10.99 feet N.G.V.D. and mean annual low of 13.19 feet N.G.V.D. In 1961, a semipermanent dam was built across the low-water channel of the St. Johns River about 0.5 mile dowstream of the lake outlet. The crest of the dam was about 12.0 feet N.G.V.D., but washouts and other damages to the structure reduced the crest to about 9.5 feet N.G.V.D. in 1975. A new sheet pile structure with a crest of 13.5 feet N.G.V.D. was completed in February 1976.

Between 1978 and 1982, minimum daily lake elevations generally remained about 13.5 feet N.G.V.D. The extended drought of 1981 caused lake water surface levels to fall below 12.0 feet N.G.V.D. between 28 June and 28 August 1981, with a low elevation of 11.49 feet N.G.V.D. occurring on 17 August 1981.

The approximate .45 foot-per-mile riverbed slope for the 7.1-mile distance between Lake Washington and Lake Winder represents the steepest stream gradient in the Upper St. Johns River Basin. Downstream of about mile point 54, the valley flood plain generally occurs at elevation of less than 15 feet N.G.V.D. Lake Winder is located at mile point 246.0. The lake is 2.8 miles long with a surface area of 2.9 square miles. The average bottom elevation is 5.6 feet N.G.V.D.

Lakes Winder and Poinsett form shallow river-run surface water storage areas in this central part of the Upper St. Johns River where the average riverbed gradient decreases to approximately .23 feet per mile. Lake Poinsett, which is 4.9 miles long, covers a surface area of 6.7 square miles and has an average bottom elevation of 5.6 feet N.G.V.D. A 37-year record for Lake Poinsett for the period between November 1941 and October 1979 indicated a lake water surface ranging between a mean annual low elevation of 9.51 feet N.G.V.D. and a mean annual high elevation of 15.06 feet N.G.V.D. Record period extremes data indicated that a maximum daily elevation of 17.55 feet N.G.V.D. occurred on 11 October 1953, and a minimum daily elevation of 7.99

feet N.G.V.D. was recorded for 18 June 1945, at the sites then in use. During the extreme drought of 1981, an estimated minimum daily elevation of 8.64 feet N.G.V.D. occurred on 11 November 1981.

The right bank, on the downstream side, of the St. Johns River at the State Highway 520 Bridge is the location of the next stream gage. This point is near Cocoa, approximately 232 miles upstream from the mouth of the river. For 29 years of record, between October 1953 and September 1982, average discharge past this station was 994 cfs, or 10.14 inches per year, from an estimated 1,331 square miles of drainage area. A maximum discharge of 10,700 cfs occurred on 11 October 1953. The minimum discharge of record, 5.6 cfs, occurred on 17 July 1981.

The river valley to the north of Lake Poinsett has a flood plain above elevation 10 feet N.G.V.D. downstream to a point about 9 miles south of State Road 50. Northward from this area to a general locality roughly 5 miles to the north of State Road 50, the flood plain gradient approximates .36 feet per mile.

A stream gage is located on the St. Johns River near Christmas, Florida, on the downstream side of the State Road 50 Bridge. For the 49 years of record between October 1933 to September 1982, average discharge past this station was 1,303 cfs or 11.5 inches per year from an estimated 1,539-square-mile drainage area. A maximum discharge of 11,700 cfs occurred on 12 October 1953. No flow occurred between 22-27 March, on 19 April, and on 12 and 13 June 1939. During 1981, a maximum daily discharge of 522 cfs occurred on 10 September and a minimum daily discharge of 2.2 cfs occurred on 12 August. During that drought year, flows of less than 50 cfs occurred between 12 April and 11 June and between 24 June and 23 August. Based upon a period of record from July 1934 to June 1977, the USGS determined that flows of 50 cfs and less for 30 consecutive days occurred at this gage at recurrence intervals of 5 years, and flows of 61 cfs and less for 90 consecutive days had recurrence intervals of 10 years.

Downstream to Lake Harney from the vicinity of mile point 204, flood plain elevations below 5 feet N.G.V.D. typically extend a mile or more on either side of the river channelway. Downstream from the vicinity of mile point 202, the riverbed occurs at elevations of less than 1 foot N.G.V.D. The 1954-55 survey data indicated that the riverbed then extended below mean sea level everywhere downstream of about mile point 197.

The general area southward of the outlet locality of the Econlockhatchee River (approximately mile point 198), where the riverbed occurs below 1 foot N.G.V.D. and where the flood plain generally occurs at elevations of less than 5 feet N.G.V.D., is identified as Puzzle Lake. Puzzle Lake essentially consists of surface water areas and temporary nutrient sinks existing as braided channel meanders and oxbow cutoffs under normal and low-flow conditions. During periods of high discharges from the river's upper reaches or the Econlockhatchee River, and when lake surface water elevations on

Lakes Monroe and Harney are high, the Puzzle Lake flood plain becomes inundated, creating a large open water expanse. Hydraulically, this area functions as an embayment headwaters, receiving and releasing water according to elevations on Lakes Monroe and Harney. During extreme low water periods, when Lake Harney's water elevation is near or below mean sea level, Puzzle Lake becomes reduced to a complex braided network of steep-banked, shallow-water, and sometimes dry channelways.

The Econlockhatchee River has a stream gage at Magnolia Ranch near Bithlo located near the center span of the bridge on Wewahootee Road. The average discharge past this station from October 1972 to September 1982 was 18.9 cfs from a drainage area of 32.9 square miles. The maximum discharge, 474 cfs, occurred on 21 and 22 June 1982. At this gage, there is no flow for many days in most years.

Middle Basin

Above Lake Harney, on the St. Johns River, another stream gage is located at the bridge on State Road 46. This gage is approximately 191 miles upstream from the mouth of the river. Over a 40-year period, July 1941 to September 1981, the maximum discharge measured was 13,800 cfs on 7 October 1953, for a drainage area of 2,043 square miles. The minimum discharge, 70 cfs, occurred on 6 November 1980. A flood in October 1924 reached a stage of 10.1 feet N.G.V.D., as measured from the flood mark.

Less than a mile downstream of mile point 191, the St. Johns River flows into Lake Harney. Based upon two U.S. Geological Survey stream gages (02234000, St. Johns River above Lake Harney, near Geneva, Florida, on downstream side of S.R. 46 and 02234100, Deep Creek near Osteen, Florida, at the confluence of Deep Creek and St. Johns River about .8 mile downstream of Lake Harney) water surface elevations in Lake Harney have fluctuated from slightly below mean sea level (m.s.l.) to over 10 feet above m.s.l. The datum of the two gages is at the National Geodetical Vertical Datum of 1929, or essentially mean sea level. For the water year 1982, the upstream gage height extremes were 7.39 feet on 31 July and .43 feet on 9 February. At the downstream gage, the gage height extremes were 9.00 feet on 9 April and .99 feet on 13 October. Lake Harney has a length of 4.4 miles with its downstream point located at mile point 186.5. The lake has a surface area of 9.47 square miles and an average depth of 6 feet.

The St. Johns River between Lakes Harney and Jessup is narrow and tortuous. The depth of the channel ranges from 3 feet to 18 feet. Small lakes are adjacent to the braided riverbed. Lake Jessup discharges into the river at mile point 174.2. The lake has a length of 9.9 miles and an average depth of 3 feet. From this point the river continues its tortuous course for about 7 miles through a braided channel with numerous oxbow cutoffs and depths ranging from 2 to 20 feet. The lower part of this river has been cut off by an approximately 6,000-foot Federal project channel, 5 feet deep and 75 feet wide, between the Osteen Bridge and Lake Monroe. Lake Monroe has a surface area of 13.8 square miles and a drainage area of 2,582 square miles. The average depth of the lake is 7 feet. For the period of record, October 1942 to September 1979, the monthly mean elevations ranged from 0.72 feet N.G.V.D. in May to 3.67 feet N.G.V.D. in October.

The next stream gage is located downstream of Lake Monroe on the Wekiva River at the downstream side of the bridge on State Highway 46. For a period of 47 years, October 1935 to September 1982, the average discharge was 286 cfs for the Wekiva River drainage area of 189 square miles. The maximum discharge of 2,060 cfs occurred on 17 September 1945, and the minimum of 105 cfs during 5-13 June 1939. The Wekiva River enters the St. Johns River at mile point 156.8. At this point the St. Johns has an authorized channel depth of 10 feet.

The St. Johns River continues to flow north to enter Lake Beresford at mile point 154.5. The average depth of this lake is 6 feet with a surface area of 1.25 square miles. A stream gage is located on the St. Johns River, 142 miles upstream from the mouth at Whitehair Bridge on State Road 44. The average discharge was 3,104 cfs for a period of 49 years from October 1933 to September 1982. The drainage area at this point is 3,066 square miles. The maximum daily discharge of 17,100 cfs occurred on 15 October 1953, and the maximum daily reverse flow of 3,030 cfs took place on 23 August 1957.

Lake George is located on the St. Johns River at mile point 110.1 and has a length of 12.1 miles. This lake is the second largest natural freshwater lake in Florida with its surface area of 73.0 square miles. It has a drainage area of 3,721 square miles. The average depth of the lake is 10 feet.

Lower Basin

For the purpose of this study, the upstream point of the Lower Basin has been designated to be at mile point 101. The Oklawaha River drains into the St. Johns at mile point 100.8. The Oklawaha River has a drainage area of 2,130 square miles and a length of 71.3 miles. The headwaters of the Oklawaha include Lakes Apopka, Harris, Dora, Eustis, and Griffin in Lake and Orange counties. These lakes are now interconnected and all drain into the Oklawaha. There are two stream gages on the Oklawaha, one of which is at the downstream side of the spillway structure at Moss Bluff Dam. This gage had an average discharge of 289 cfs over a 27-year period for the 879-square-mile drainage area. The maximum daily discharge of 1,960 cfs was on 30 September 1979. The structure's gates were closed and there was no flow for many days during 1973 and 1974.

The other stream gage on the Oklawaha is at Rodman Dam at the downstream side of the control structure. This point has a drainage area of 2,747 square miles which includes Paynes Prairie in Alachua County, a diked sinkhole area of 650 square miles which is noncontributory except for pumpage. The average discharge over a 14-year period, October 1968 to September 1982, was 1,523 cfs. The maximum daily discharge of 9,560 cfs occurred on 5 February 1970. On 9 March 1969, the gates were closed and flow consisted only of unknown leakage.

The St. Johns River continues its winding path northward to its junction with the easterly terminus of the Cross-Florida Barge Canal works. A stream gage is located at the downstream side of Buckman Lock. For the period of record, December 1969 to September 1982, the maximum daily discharge of 199 cfs occurred on 27 May 1978. There is no flow for many days each year.

Dunns Creek enters the St. Johns River from the east at mile point 86.4. This creek drains from Crescent Lake into the St. Johns. The lake has a surface area of 27.0 square miles and a drainage area of 456 square miles. Crescent Lake is 13.8 miles long with an average depth of about 10 feet.

The stream gage at Palatka is located near the right bank of the river at Edgewater Light 13, 84 miles upstream from the mouth of the St. Johns. The average discharge for a 12-year period is 5,945 cfs for the 7,094 square-mile drainage area (including Paynes Prairie in Alachua County). The maximum daily discharge of 31,300 cfs was on 5 November 1970 and the maximum reverse flow of 20,400 cfs occurred 6 June 1968.

Downstream from Palatka, the St. Johns widens into an elongated embayment at points exceeding 3 miles in width as it nears Jacksonville. Black Creek, with a drainage area of 474 square miles, enters the river at mile point 44.9 with a mean discharge of 200 cfs. Julington Creek drains into the river at mile point 39.6. Doctors Lake drains into the St. Johns at mile point 37.5 in Orange Park. This lake, with a surface area of 5.31 square miles, has a drainage area of 22.4 square miles and an average depth of about 11 feet.

The Ortega River enters the St. Johns at mile point 27.1 where the river is nearly 3 miles wide. This tributary river has a length of 22.8 miles and a mean discharge rate of 45 cfs. The St. Johns River narrows and deepens considerably as it passes through downtown Jacksonville; near the Florida East Coast Railroad Bridge, it reaches a depth of 80 feet. A stream gage is located at this railroad bridge, 24.9 miles upstream from the mouth. The average discharge measured was 5,546 cfs over a 21-year period for a drainage area of 8,754 square miles (including Paynes Prairie). For the water years 1954-1970, the maximum volume of flow downstream, 5,280 million cubic feet, occurred on 10 September 1964, and the maximum volume of flow upstream, 4,410 million cubic feet, occurred the previous day, 9 September 1964. Hurricane Dora passed across the area at that time. The water years 1971-1974 had a maximum daily discharge of 64,000 cfs on 20 June 1972 and a maximum reverse flow of 62,700 cfs on 20 October 1972.

Arlington River joins the St. Johns at mile point 21.5. Near this area, the navigation channel in the St. Johns is 575 feet wide and 34-38 feet deep. Downstream from this point, the river has a channel 38 feet deep with a width ranging from 400 to 1,000 feet out to the ocean. Trout River drains into the St. Johns at mile point 16.6. Mill Cove is adjacent to the St. Johns and drains an area of about 25 square miles. This cove is shallow; depths range from 1 to 4 feet. The Atlantic Intracoastal Waterway follows Sisters Creek into the St. Johns at mile point 5, crosses the river, and extends southward along Pablo Creek. The Intracoastal Waterway has a project depth of 12 feet. At its juncture with the ocean, the St. Johns River has a maximum discharge rate of 61,100 cfs and a maximum reverse flow of 51,040 cfs.

Tidal fluctuation has considerable impact on the St. Johns River. Tidal movement in the river continues all the way upstream to at least Lake George (mile point 110.1). The ocean tide at the entrance to the St. Johns River has an average rise and fall of 4.9 feet. As the tide wave advances up the river, its amplitude decreases continually for a distance of about 35 miles. In the vicinity of Orange Park, the average range of tide reaches a minimum of 0.7 foot. Above this point, the range gradually decreases for another 35 miles to Palatka, where the average rise and fall is .2 feet. Above Palatka, the tidal range becomes less discernable, and at Lake George it is practically zero.

In the entrance to the St. Johns River the tidal current is of the reversing type. The flood current flows upstream for a period of about 6 hours and the ebb current for a like period in the opposite direction. The currents in the St. Johns River, at times, are modified considerably by wind and freshet (a rush of fresh water flowing into the ocean) conditions. Northerly and northeasterly winds increase the velocity and duration of the flood stream and decrease the ebb. Southerly and southwesterly winds have a reverse effect. Freshets, which usually occur in the autumn months, increase the flow in the ebb direction and diminish the flow in the flood direction.

GENERAL WATER QUALITY CHARACTERISTICS

General

Water quality conditions in the St. Johns River Basin are generally understood within a broad, conceptual framework. The general geochemical processes that affect water quality are well recognized, but current knowledge of specific causes of water quality conditions within the river system remains very limited. Water quality at any discrete locality with the St. Johns River system is the result of complex interactions of chemical and biological processes that operate within the water as it responds to physical conditions on watersheds and stream hydrodynamics. Because of the constant interplay of physical, chemical, and biological processes, it is often difficult to draw definitive conclusions of water quality impacting conditions from historical data and loosely structured water column sampling programs.

Data collected for localities in the St. Johns Basin over the years reflect physical water column conditions and sampling efforts of the collection timeframes, but the actual physical conditions occurring at the time of sampling often were not documented. Such data are primarily useful as general information. Very few early survey efforts have sufficient supporting records to permit their use for statistical or other analytical purposes. Many factors can influence the results of water column data collected for specific purposes. Even current survey efforts sometimes demonstrate insufficient or questionable sample program efforts and support information. As a result, conclusions regarding water quality conditions based solely upon water column data should be accepted with a clear understanding of the variability in current knowledge and its limitations.

For example, contributions of deep aquifer groundwater contributions to surface flows in the Upper and Middle St. Johns River have been documented through chemical analyses and U.S. Geological Survey water resource investigations, but sources and extents of such flows are only generally understood. Sources of ground water for this part of the basin are considered to be adjacent and nearby upland recharge areas. Some of these upland recharge areas underlie the now rapidly urbanizing Orlando Metropolitan Area in Seminole and Orange Counties. Nationwide, a variety of toxic substances have been associated with industries and urban environments. The degree of introduction of toxic substances into groundwater recharge areas of the Orlando metropolitan area is unknown. Deep aquifer waters are widely used in the region for potable and agricultural uses. Any significant toxic substances contamination of uplands recharge areas can have long-term effects upon deep aquifer water supplies and, through seepage, the water quality in the St. Johns River system. No program yet exists to establish existing conditions and review the long-term potentials of such hazards in the basin.

Upper Basin

This report includes more water quality information on the Upper Basin than the remainder of the river. The Corps of Engineers began an investigation of the flood control needs in the Upper Basin in 1954. In coordination with the St. Johns River Water Management District, a new, semistructural plan for water control has been prepared for the southern half of the Upper Basin. This effort has included a variety of analyses by a large number of agencies concerned with the area.

Within the Upper basin, the Florida Department of Regulation has classified the surface waters of the St. Johns River and its tributaries southward from Lake Washington to the Indian River County line as Class 1-A, Potable Water Supply. Lake Washington is a surface water supply source for over 90,000 residents of south Brevard County. Downstream of Lake Washington, the river is classified as Class III, Recreation-Propagation and Management of Fish and Wildlife Surface Waters.

The most recent Corps of Engineers water quality report for the Upper St. Johns River Basin represented sampling at 28 sites in the Upper Basin during the period May 1975 to January 1980. The following is a summary of report findings for this period of analysis:

Summary. The main stem and its lakes are moderately hard with high levels of dissolved inorganic ions. In addition, the concentrations of these inorganic ions increase downstream due to groundwater inflow from irrigation and natural artesian discharge.

Total nitrogen and phosphorus concentrations in the main stem and lakes exhibited little variations. Although total phosphorus concentrations appear high, they are within the expected range for this area since extensive phosphate deposits exist in this basin.

The dissolved oxygen concentration is higher in the lakes on the main stem than in the river. This is probably due to wind action on the lake surface and the greater oxygen production by photosynthesis.

The water quality of the tributaries was variable and depended on the area they drained. Total nitrogen and phosphorus concentrations were highest for the Econlockhatchee River which receives sewage effluent and urban runoff from the Orlando area. The St. Johns River at Highway 46 has the highest total phosphorus and nitgrogen concentrations of the river channel stations due to the influence of the Econlockhatchee River. Total phosphorus was higher in the upland tributaries than in the main stem.

The upland tributaries are soft with low levels of dissolved inorganic ions, whereas, Rockledge Creek and Unnamed Canal are hard with high levels of inorganic ions. Unnamed Canal drains agricultural land and receives ground water used for irrigation. Rockledge Creek drains a residential area with many free flowing artesian wells.

The waters of Taylor Creek Impoundment are softer and have a lower alkalinity and lower concentration of the major inorganic ions than the other stations in this study. This is due to dilution of any mineralized inflow by the large volume of water stored in the impoundment. However, the nutrient concentrations are similar to the other stations.

The concentration of major inorganic ions as well as alkalinity and specific conductance declined during 1979 from the average values found during the baseline period. This trend was most pronounced in the northern portion of the river which has a high inflow of mineralized ground water from irrigation and natural artesian discharge. This is probably due to several severe droughts during the baseline period. High mineral concentrations during dry times are probably due to the fact that the natural groundwater inflows were diluted less by rainfall and runoff. Furthermore, a greater quantity of ground water was used for irrigation at the same time. Another cause for this difference between the baseline period and calendar year (CY) 1979 may have been the large quantity of rainfall during 1979.

Even though a majority of stations in this study exhibited lower nutrient concentrations during CY 1979 than during the baseline period, this does not necessarily indicate a decrease in nutrient inflows to the river. More information about the drainage area is necessary to determine if this was the reason or if dilution by increased rainfall was the cause.

Since the concentration of oxygen in the water is variable and depends upon temperature, the degree of biological activity, the rate of diffusion from the atmosphere, and salinity, it is not possible to determine whether there was a difference in dissolved oxygen concentration between CY 1979 and the baseline period.

An evaluation of the data leads to the conclusion that the water quality is acceptable for most uses. However, the basin does not meet Class I-A or Class III standards at any of the sampling stations. All stations had periodic oxygen levels below 5 mg/l and mercury levels above .0002 mg/l. In addition, Rockledge Creek, two of the three stations at Taylor Creek Impoundment, and 9 of the 10 stations below the dam at Lake Washington exceed the State standards for iron. Finally, 16 of the 23 stations throughout the basin exceed the State standard for zinc.

The following water quality information for the Upper Basin was extracted from the Florida Department of Environmental Regulation (FDER) summary of water quality conditions on the St. Johns River for 1982, as developed in response to Section 305 requirements of Public Law 95-217.

Field responsibility for the St. Johns River within FDER is divided between two district offices. The Orlando District Office has jurisdiction over the Upper St. Johns River from the headwaters downstream through Lake George. The Jacksonville Subdistrict Office, under the administration of the district office, has responsibility for the river from Lake George downstream to the river's mouth at the Atlantic Ocean. For this report, the FDER water quality finding excerpts are arranged by the format of this report.

Water quality evaluation is based on the Fixed Station Monitoring (FSM) monitoring sites. The FSM (Permanent Network Station) (PNS) program had its beginning in late 1973 and consisted of monthly chemistry monitoring and quarterly biological monitoring until 1980 when chemical monitoring was reduced to quarterly at most stations (Florida Department of Environmental Regulation, 1980; Ross and Jones, 1979). Water quality is discussed following direction of river flow from south to north:...

A. Blue Cypress Lake--This lake is in the St. Johns River headwaters and maintains excellent water quality.

B. St. Johns River at the Lake Washington Dam--Occasionally has low dissolved oxygen (D.O.) and has greatly fluctuating conductivities. No noticeable change has occurred since 1973....

From just north of Blue Cypress Lake through Lake Poinsett, the main pollution problems are:

1. Pump water from agricultural drainage canals. In most cases, this is poor quality water from highly organic soils and groundwater which, by pumping to canals, is denied the benefit of marsh flood plain treatment.

2. Encroachment on the flood plain for agricultural purposes resulting in the elimination of marshes which are essential for the filtering of pollutants and storage of water (Cox and Moody, 1976).

3. Canalization causing intrusion of groundwater with high chlorides allowing rapid rates of runoff, wasting water and carrying pollutants downstream. The upper river near its origin has been extensively modified by canals and dikes.

4. Hyacinths and the associated problems of hyacinth control, such as introducing a heavy load of organic matter in the form of decaying vegetation into the water. If not controlled, navigation is blocked. Hyacinths proliferate in agricultural and drainage canals.

5. Periodic fish kills associated with large scale agricultural pumping operations. For example, large fish kills were observed in July and August 1978, at which time, basically no D.O. was found in the river water from north of Blue Cypress Lake all the way to north of Lake Poinsett (Mason and Belanger, 1979)....

C. Econlockhatchee (Econ) River (a large tributary to the St. Johns entering near S.R. 46)--This river has very high nitrogen and phosphorus concentrations, also very high BOD's and periodically low D.O.'s. These problems stem from the Little Econlockhatchee which is the tributary that directly receives the effluents from many sewage treatment plants in the greater Orlando area....

The Econ, with fairly rapid flow and shaded by trees, is handling quite well the pollution load it receives. It is ecologically very well balanced...but supplies a huge load of nutrients, particularly phosphorus to Lake Harney and the downstream St. Johns River.... At certain times of the year, the poor water quality of the Little Econ greatly elevates the total phosphorus, the total nitrogen, and the biochemical oxygen demand of the Big Econ and at the same time lowers the dissolved oxygen content....

The two preceding evaluations reflect the more common raw water column data appraisals and subjective conclusions now generally used in stream water quality analyses. A somewhat more analytical evaluation that reflects geochemical bases for observed water quality was conducted by Jeffrey Leed and Thomas Belanger as graduate research at the Florida Institute of Technology. Their investigation illustrates probable trace metal pathways functioning within the basin. For this research, field sampling was conducted at 42 stations between the stream course headwater region above Lake Helen Blazes and Lake Poinsett. The collections were taken between April and September 1978.

Summary and Conclusion. Findings from our research indicate that:

a. Although total copper and total zinc were present in low concentrations in the surface waters of the upper St. Johns River, total iron frequently occurs in concentrations exceeding the State standards of 300 ug/l set by the Florida Department of Environmental Regulation for Class I waters.

b. Levels of total iron in the surface waters of the upper St. Johns River appear to be regulated by resuspension of bottom sediments caused by increased discharge and resulting turbulence.

c. Groundwater inputs from springs, wells, or upward seepage through the lake and canal sediments may also influence the trace metal content of the surface waters. Because total iron concentrations in nonartesian ground water are high, significant contributions of iron are likely to be added to the surface waters from nonartesian or bank seepage.

d. Average surface water total iron concentrations were highest in the headwaters region of the river above Lake Helen Blazes, decreased in a northward direction to Lake Washington, and increased to Lake Poinsett. Highest average concentrations of total copper and total zinc were measured in the surface waters of Lake Poinsett and Lake Washington, where groundwater seepage and land runoff into the drainage canals add elevated levels of trace metals into the main stem of the river. Groundwater inputs, particularly from nonartesian wells, are thought to be responsible for increasing surface water concentrations of total iron in the headwater region of the upper St. Johns River.

e. Higher levels of iron..., copper..., and zinc...were found in sediments containing higher percentages of organic matter (volatile solids), suggesting that humic substances deposited in these sediments during decomposition of vegetation complex with metal ions, forming a sink for the metals.

f. Analysis of iron, copper, and zinc in the tissues of largemouth bass, speckled perch, eastern chubsucker, and bluegill indicated that these metals are concentrated in the fish liver, while lower concentrations are found in the gill and lowest levels are found in muscle tissue. Exceptions to this trend were the gills of speckled perch and bluegill where higher average copper and zinc concentrations occurred, respectively. Statistical results suggested that iron accumulates in the liver of largemouth bass through time and that more efficient means of excreting copper and zinc are available to the largemouth bass and bluegill as the fish ages.

g. Multiple regression techniques used to evaluate water quality-land use relationships demonstrated that levels of total copper and total zinc were highly correlated to land uses associated with urban activities. Average total copper concentrations were best predicted by an equation using percent residential land use, while total zinc levels were best predicted using percent commerical-institutional-industrial use or one using percent residential use. These results indicate that as the extent of human utilization of undeveloped watersheds increases and natural cover decreases, total copper and total zinc concentrations can also be expected to increase in the surface waters of the upper St. Johns River.

Middle Basin

A eutrophication and water quality analysis of Lakes Harney, Jessup, and Monroe; the St. Johns River connecting the lakes; and tributary streams to this part of the basin described as the Middle St. Johns River Basin was undertaken through the University of Florida, Department of Environmental Engineering Studies, for the Florida Department of Environmental Regulation. Field data were collected during the summer 1974 through the winter 1975. The summary of this report presented below describes the water quality conditions of this three-lake part of the Middle Basin.

Water quality in the Middle St. Johns system is highly variable both spatially and temporally. The river dominates conditions in the main channel lakes, especially during high flow. Dissolved solids is high at all times in the river and channel lakes, but summer high flows exert a diluting effect, bringing in highly colored, nutrient laden water. Secchi disk transparencies are probably always low (less than 1 m) in all three MSJ lakes, either because of high color or because of algal turbidity. Lake Jessup is demonstrably the most eutrophic of the three lakes with large quantities of blue-green algae (primarily Microcystis) and apparently year-round low transparencies. Algal populations were low in the channel lakes during our field trips. However, nutrient levels are high in these lakes and algal blooms surely occur when physical conditions are favorable. Based on consideration of the chemical and biological water quality data, Lake Jessup can be classified as hypereutrophic, Lake Monroe as eutrophic and Lake Harney as mesoeutrophic. Benthic invertebrate data support the conclusions. The Lake Jessup benthos had a low diversity and was dominated by a single species of pollution tolerant sludgeworm (Limnodrilis hoffmeisteri). The other two lakes had more diverse fauna but were still dominated by tubificids. No pollution intolerant forms were found in any of the lakes.

The water quality conditions measured in the MSJ lakes during this study are probably typical of high flow and early low flow conditions. However, much larger extremes in flow occur in the system than were noted during the approximately six month interval in which our samples were collected. Obviously, a much broader range of water quality conditions can occur in the MSJ lakes than were described in this chapter; this is especially true for spring time extreme low flow conditions when the warm weather and long residence times may stimulate much greater planktonic activity in the chain channel lakes.

Finally it is recognized that the brief stream sampling conducted for background information purposes in this study is wholly inadequate for pollutant flux measurements. While the Econ River and Middle St. Johns River have been relatively well monitored in the past, more information is needed on the other tributaries.

Further studies should be directed to monitoring storm events and high flow conditions rather than to routine (once a month) sample collections.

The Middle St. Johns River Basin Study established preliminary water retention times for the three lakes and developed initial information on oxidation of organic compounds and other processes. These lakes apparently function in manners similar to other Florida lakes, permitting time for biochemical actions in the water to oxidize or assimilate nutrient loadings before water is discharged to the downstream river. While numerous water quality samples have been taken on these and other Florida lakes, little effort has been directed to establishing the natural assimilative functions of these bodies. In this process essentially all large lakes in Florida tend toward eutrophism and accumulate organic sediments. During periods of high flood flows in those parts of the lakes where velocities are sufficient and water turbulence extends to the substrate, still uncompacted sediments are picked-up from the substrate and carried downstream. While this process is generally recognized, the natural oxidation and sediment settling functions of Florida lakes; their natural tropic conditions; and their roles in sediment storage, sediment related organic fraction digestion, and subsequent retransport of more completely digested organics have not been given significant consideration.

Downstream of Lake Monroe in the Middle Basin very limited investigation of the river water quality has been undertaken. Data have been collected by a number of agencies, but efforts to establish statistical relationship-type information useful for environmental assessments are not available. The following continuation of excerpts from the 1982 FDER Report provides an appropriate synopsis of known water quality conditions for the Middle and Lower Basin.

A. St. Johns River at State Road 46 - DO is occasionally less than 5 mg/l and phosphorus is periodically high. It is a moderately polluted area, but has not changed noticeably since monitoring began.

B. Lake Harney - Phosphorus concentrations are high. This is a moderately polluted lake which has maintained fairly balanced ecological communities since 1970.

C. Lake Jessup (a large tributary lake entering the St. Johns a few miles downstream of Lake Harney) - This area has some of the poorest water quality of the Upper St. Johns River Basin. DO levels are above saturation, and high BOD, pH, nutrients and suspended solids indicate severe eutrophication in Lake Jessup. Macroinvertebrate diversities are low and benthic fauna is dominated by pollution-tolerant organisms. Phytoplankton counts are high and frequently dominated by nuisance and toxic blue-green algae. The main sources of the problems are sewage treatment plants, most of which will be phased out and connected to the recently completed Iron Bridge Regional Wastewater Treatment facility....

D. St. Johns River at Sanford (U.S. 17-92) - Phosphorous concentrations and BOD are high. Still a moderately-polluted area, but it has improved somewhat since 1973....

E. Wekiva - Little Wekiva Rivers (large tributary system entering the St. Johns a few miles downstream of Sanford) - This system is greatly improved due to upgrading sewage treatment plants and phasing out of others. A large industrial complex has also greatly improved the quality of its discharge. This tributary system is in very good condition as it enters the St. Johns....

F. St. Johns River at Astor (just upstream from Lake George) - Water quality has improved somewhat. D.O. content increases and total nitrogren and total phosphorus levels decrease. Macroinvertebrate diversities are normally good. This improvement may be partially related to the large percentage of forest land between Lake Monroe and Lake George helping to maintain water quality....

G. St. Johns at Outlet of Lake George - From Lake George on downstream the natural conductivity (salinity) increases greatly, due to the inflow of salt springs and ground water with high mineral content. Over the years, the total nitrogen has decreased somewhat, and the area maintains fair water quality....

The bottom of the St. Johns River throughout the Middle and Lower Basins is below sea level, and surface water elevations for these subbasins normally fluctuate from a few feet above mean sea level to slightly below sea level. As a result, tidal influences exist throughout these subbasins, and during severe droughts, the marine salt water wedge can be expected to penetrate upstream in the river well into the Middle Basin.

The Middle Basin is currently considered to receive substantial surface water contributions from seepage and spring discharges. The U.S. Geological Survey has determined that springs that discharge water from the Floridan aquifer have primarily calcium-magnesium bicarbonate water reflecting solution of limestone and dolomite rock. About 10 percent of the springs, such as Blue Springs in Volusia County, discharge waters high in sodium cloride. Another 10 percent, such as Beecher Springs, in Putnam County, have mixed water discharges containing small concentrations of sea water. Silver Springs, which discharges to the Oklawaha River and Lake Ocklawaha, has been estimated to discharge about 540 tons of dissolved rock material per day to the surface water system.

Lower Basin

The following excerpts from the Florida Department of Environmental Regulation 1982 report illustrate general conditions on this subbasin:

> ...The entire lower reach of the St. Johns River is subject to wind and tidal influence. The low gradient in the St. Johns River, combined with the effects of low flow and wind direction, result in short-term reverse flows as far south as Lake George. Although these reverse flows may continue for several days, there is a net downstream flow approximately seventy-five percent of the time for the entire river system.
>
> Forest land continues to be the major land use in the Lower St. Johns River Basin except near Jacksonville, where more than twenty-five percent of the land use is urban. Pollution sources in the Lower St. Johns River Basin include urban runoff, sewage effluent, pulp and paper mill effluent, and numerous other industrial discharges." (Florida Department of Environmental Regulation, 1980)....

The point source inventory lists 48 industrial sources, 116 Class A, B, and C (Domestic Waste Sources) and an additional 206 permitted sources having an average daily flow under 25,000 gallons each, all contributing wastewater effluents to the Lower St. Johns River. Of these 206 minor sources, 172 are generally meeting the standards set for them, and 34 are not in compliance. Thus, there are 370 known and permitted point sources of varying amounts of pollutants being released directly to the surface waters of the St. Johns River and its tributaries in this subbasin area.

The waters of the St. Johns River is in fairly good condition north of Lake George until it enters Duval County. Water quality decreases in the main river, but not drastically. It improves again before it reaches the Atlantic Ocean.

Tributaries receive the major portion of the waste elements and carry them to the St. Johns River. The two tributaries of significant size north of the Oklawaha River is Dunn's Creek....

A. Oklawaha River Downstream of Rodman Reservoir (a very large tributary river) - In the reservoir itself, there are extreme aquatic plant problems with water hyacinths and hydrilla, with resultant D.O. problems at certain times. The reservoir is a part of the Cross-Florida Barge Canal Project which has been deauthorized by the State. Similar action on the federal level is pending. Also, a restoration project for this area is being considered. The Oklawaha puts water of farily good quality into the St. Johns....

(Note: The Corps of Engineers conducts routine water sampling on the Lake Ocklawaha part of the Cross-Florida Barge Canal. These data are retained to be analyzed on a need basis. Sampling will be continued until the project is completed or deauthorized. Water quality on Lake Ocklawaha varies seasonally in response to drawdowns conducted for aquatic weed control. The lake serves to dilute waters from tributary streams and assimilates impact loads.

B. Dunn's Creek - This creek connects Crescent Lake to the St. Johns River and drains areas from Flagler and Putnam Counties, including effluents from two municipal sewage systems, but more importantly, from the rich fertilized farms of the area. Dunn's Creek, therefore, contributes some nutrients to the main stream. The effect of this contribution is muted before much distance is covered....

C. St. Johns River at Palatka - Salinities are high from here on to the Atlantic and reflect the effect of the salt wedge from downstream as well as the salt springs to the south. Data indicate fair to generally good water quality in this area....

Total Kjeldahl nitrogen and total phosphorus levels gradually increase from Palatka to just south of Jacksonville at the salt/fresh water interface where total phosphorus concentration peaks, and TKN drops sharply. Dissolved oxygen averages, which decline gradually moving downstream, also drop abruptly south of Jacksonville where significant tidal mixing occurs. Nitrate concentration increases sharply in this area and continues to increase toward Jacksonville.

D. The Ortega/Cedar River System at Jacksonville - The Ortega/Cedar River system is the first major source of deteriorated water to enter the main stream in the lower St. Johns River section.

E. St. Johns River at Main Street in Jacksonville - Water quality is poor in the Jacksonville urban area.

Water quality in the St. Johns River appears to be degraded near the Jacksonville urban area. In addition to the high concentrations of phosphorus and nitrate-nitrite nitrogen, and low DO averages in this portion of the river, fecal and total coliform counts are high.

...tidal influences are strong and as a result, the picture drawn is not clearly presented. The downtown area also receives a high nutrient concentration from the Arlington River; and further downstream, the Trout River. Both streams carry pollution burdens from a large number of domestic treatment plants.

Annual reports for 1982 and 1983 from the City of Jacksonville's Environmental Protection Board indicate significant progress by the city in improving the area's water quality. With few exceptions, bacteriological standards for Class III recreational waters are now being met on the main stem of the St. Johns River. However, high bacterial counts still occur on numerous tributary streams. In cooperation with the Florida Department of Natural Resources, the City's Bio-Environmental Services Division (BESD) initiated monthly sampling for arsenic, copper, cadmium, lead, and chromium in the area's Class II shellfish harvesting waters. No State standard violations were found. A one-time five-site sampling effort also was conducted in the Ft. George Island area. State standard violations for copper and pH were identified. Fish flesh was sampled for mercury content in the Blount Island area beginning in November 1981. Through 1983, no concentrations exceeding the FDA limit of 1 ug/g were found. Still other sampling efforts found evidence of PCB's in sediments of the Arlington, Ortega, and Cedar Rivers. The local agency recognized the potential problems associated with stormwater runoff from urban access, but, to date, lacks resources to conduct a sufficiently controlled sampling program to establish the statistical significance of postulated contamination from this source.

Review of available materials on the Lower Basin river conditions indicated an absence of information on wind effect impacts upon river water quality. The 60 mile reach of the St. Johns River between Palatka and Jacksonville is subject to substantive wave generation and vertical mixing of water due to wind effects. In this reach, the river occupies a broad, shallow depression with a width of nearly three miles at some locations. Persistent winds crossing the river from east to west or the more predominant northerly and southerly winds generate currents and vertical turbulence in the water column. Due to the shallow water conditions, resuspension of bottom sediments due to wind action should be considered a normal occurrence.

Summary

Review of literature related to water quality of the St. Johns River demonstrates that limited technical information is available upon which to base management decisions. The Upper Basin has undergone the most intensive analyses of the three main-stem segments, but these evaluations largely reflect assessments based upon raw water quality data and comparisons with State of Florida water quality standards. Upper St. Johns River Basin river flow models were developed to evaluate flood flows and water control measures to maintain and enhance marsh and swamp conditions. The water quality impact investigations were limited to these project purpose evaluations. The Lower Basin in the vicinity of Jacksonville has been studied, and sufficient technical information probably exists to permit an analytical process to provide improved knowledge of river dynamics and for water quality management purposes. Nonpoint pollution problems on major tributaries in Jacksonville are generally recognized, but local capabilities for structuring and conducting more definitive analyses on these problems are lacking. Between Jacksonville and the Upper St. Johns Basin, the main stem of the river is known only through periodic general water column samples taken at U.S. Geological Survey gaging sites and by several state agencies. Further investigations are needed to determine flow characteristics and geochemical related water quality conditions for the entire Middle Basin to establish fundamental assimilative capacity characteristics of the river and Middle Basin lakes under seasonal conditions. Information on groundwater contributions to the river and contributions of these sources to in-stream water quality is very limited. Very little information has been developed to date regarding the presence of metals and toxic substances within sediments and benthic and sessile organisms within the river system. Efforts to establish the relationship between river bottom sediments and sediments transported from watersheds apparently have not been undertaken. Similarly, no reports were identified which indicated efforts to establish the effects of chemical constituent interchange between bottom sediments and the water column. Some usable data have been collected and are retained in electronic computer data bases, but correlative analyses of these data remain to be developed.

WATERWAYS USAGE

General

Four principal waterways are associated with the St. Johns River system. These are: (1) Sanford to Jacksonville, with river improvements between mile point 169.5 above Lake Monroe and mile point 24.9 at downtown Jacksonville; (2) the Cross Florida Barge Canal improvements consisting of Lake Ocklawaha, Henry H. Buckman Lock, and channel improvements to Palatka; (3) Jacksonville Harbor, which extends from downtown Jacksonville to the Atlantic Ocean; and (4) the two Atlantic Intracoastal Waterway segments between Norfolk, Virgina, and Miami, Florida.

Historical Background of Navigation Improvements

A letter from the Secretary of War, dated 6 June 1898, introduced navigation problems on the St. Johns River. Vessels could not reach Orange Mills Flats, 7 miles below Palatka from Jacksonville, while fully loaded. The depth of water prevented vessels drawing 15 to 18 feet from reaching the industries located near Palatka. This area was becoming an important commerce center. A large lumber business with mills, a door factory, and a sash factory were in operation at that time. This was also the terminus of several railroads. A channel, 13 feet deep, was requested and authorized in 1899.

Additional improvements were made to the river for the purpose of stimulating commercial growth. The section between Sanford and Lake Harney was found worthy of improvement in a letter from the Secretary of War dated 8 December 1908. After World War I, the central portion of Florida increased its production of vegetables and citrus fruits. At that time, there were not enough railroads to transport these perishable goods so the attention was once again turned to the St. Johns River. Additional improvements were requested in 1927 from Jacksonville to Sanford to allow for greater water transportation. Deepening of the river channel would also benefit the lumber industry which had already benefited by the 13-foot channel.

During World War II, no improvements to the river were funded since they would not directly benefit the war effort. Following the war, recommendations were made to increase the channel depth from 10 feet to 12 feet from Palatka to Sanford. Currently the channel is 13 feet deep and 200 feet wide between Jacksonville and Palatka, 12 feet deep and 100 feet wide between Palatka and Sanford, and 5 feet deep and 100 feet wide between Sanford and the Osteen Bridge above Lake Monroe (plate 3).

The Jacksonville to Sanford waterway connects with the Jacksonville Harbor Project at the Florida East Coast Railroad Bridge (table 2) about 25 miles upstream of the mouth of the St. Johns River. The authorized channel of the Jacksonville Harbor Project is 30 feet deep and 300- to 600-foot wide from the

Florida East Coast Railroad and Acosta Bridges to Commodore Point, then 34 feet deep by 590 feet wide via terminal channel to mile point 20, and then 38 feet deep by 400 to 1,200 feet wide to the ocean (plate 2).

Jacksonville Harbor. The annual commercial tonnages passed through the harbor have varied over the past 10 years, with a sharp decline in 1982. These annual tonnages are as follows:

Year	Tons*	Year	Tons*
1973	15,513,590	1978	15,712,893
1974	14,794,938	1979	15,278,008
1975	13,495,764	1980	15,644,000
1976	14,397,951	1981	15,843,690
1977	15,108,032	1982	12,892,163

*Source: Waterborne Commerce of the United States, CY 1982, Part 1 - Waterways and Harbors, Atlantic Coast, Department of the Army, Corps of Engineers WRSC-WCUS-82-1.

The Jacksonville Port Authority owns and leases four major container and general cargo terminals which are:

1. Blount Island. This terminal handles containers, RO/RO trailers, imported autos, scrapmetal, crated auto parts, and paper products. All ship berthing at the facility is along 3,550 linear feet of bulkhead hence no slips or piers are constructed at the terminal. A T-shaped RO/RO platform extends out from the wharf on the far western edge of the bulkhead line. Plans are being made for a 1,150-foot easterly extension of the existing wharf, bringing the total bulkhead length to 4,700 feet.

2. Talleyrand Terminal is located about 20 miles from the ocean and is at the upper limit of the 38-foot channel. Talleyrand includes 2,838 feet of contiguous wharf, over 13.8 acres of covered storage, and 111 acres of paved, lighted, and fenced open storage. Coffee, automobiles, petroleum, lumber, tires, and steel are the major commodities handled through the terminal.

3. Sea-Land Terminal. Approximately 12,000 containers a year pass through this terminal destined for foreign ports. It has 16 acres of open storage and a 1,200-foot wharfline.

4. Eighth Street Terminal. It has approximately 1.5 acres of transit shed area and about 31 acres of open storage. Automobiles are landed on the terminal's 707-foot wharf and processsed at the terminal before being delivered to dealers.

Private bulk terminals for handling petroleum dot the northern and western shore of the river between miles 15 and 19. A liquid and dry bulk facility located at mile 18 is a large exporter of phosphate rock and superphosphoric acid, a highly refined, concentrated form of phosphate used in the production of agricultural fertilizers. Storage facilities include six concrete silos, each with a design capacity of 5,000 tons of rock and six rubber-lined steel tanks with a design capacity of 15,000 metric tons of acid each.

Jacksonville has major ship repair accommodations with a dry dock able to lift vessels up to 125,000 deadweight tons. It offers a clear width of 144 feet inside wing walls and has served vessels with an overall length upward of 900 feet. The facility is located in downtown Jacksonville and maintains three dry docks and nine wet berths. Other ship building and repair facilities operate in the Jacksonville area, but on a smaller scale

Intracoastal Waterway. Annual tonnages carried along the intracoastal waterway from the St. Johns River to Miami are as follows:

Year	Tons	Year	Tons
1973	1,182,475	1978	1,187,362
1974	1,505,534	1979	1,475,654
1975	1,228,098	1980	1,214,075
1976	1,393,370	1981	1,021,788
1977	1,269,218	1982	1,103,955

St. Johns River, Jacksonville to Lake Harney. The St. Johns River is currently being used for commercial traffic. The annual tonnages of freight traffic have decreased during the period 1978-1982. Data for the 10-year period 1973-1982 appear below.

Year	Tons	Year	Tons
1973	1,058,297	1978	1,558,423
1974	972,954	1979	1,516,374
1975	1,154,664	1980	1,476,207
1976	1,231,882	1981	1,849,213
1977	1,160,926	1982	1,118,148

The largest use of freight traffic in 1982 was to transport residual fuel oil. This accounted for 95 percent of the total freight traffic on the river.

1982 FREIGHT TRAFFIC*
ST. JOHNS RIVER, JACKSONVILLE TO LAKE HARNEY

Commodity	Short Tons
Fresh fish, except shellfish	20
Residual fuel oil	1,063,688
Jet fuel	50,772
Naptha, petroleum solvents	3,668
Total	1,118,148

*Source: Waterborne Commerce of the United States. CY 1982, Part 1 - Waterways and Harbors, Atlantic Coast, Department of the Army, Corps of Engineers WRSC-WCUS-82-1.

The principal users of residual fuel oil are power plants located along the river. Florida Power and Light operates two of these plants - one at Sanford and one south of Palatka. They have recently initiated a change over to a "coal-by-wire" system in which they receive electrical power from overhead lines for retransmission. The change over reduces the utility's dependence upon fuel oil which will be reflected in future freight traffic reports and a decline in the residual fuel oil tonnages.

Cross Florida Barge Canal. The Cross Florida Barge Canal is incomplete and commercial traffic is limited to charter fishing and sightseeing activities. Lake Ocklawaha is utilized for surface water recreational activities.

Other Recreational Activities. The St. Johns River is heavily used for various recreational boating activities. The Lower Basin waterways are very heavily utilized by the Metropolitan Jacksonville Area population. The remainder of the Lower and Middle Basins also have been reported to be popular and widely used for surface water recreational activities. The extent of this utilization has not been determined.

INTERIM WATER QUALITY MANAGEMENT PLAN FINDINGS

GENERAL

Under the directive of Public Law 98-50, this report constitutes an interim water quality plan for the St. Johns River Basin. The report findings include elements identified by the St. Johns River Water Management District and others. Emphasis has been placed upon the Water Management District's interest in obtaining guidance and information suitable for their general water management needs. Information on alternative efforts for these purposes are included in this report. Accordingly, this Interim Water Quality Management Plan focuses upon technical aspects of water quality and related informational needs. No attempt was made in this effort to conduct a detailed review of local, State, and Federal regulations and the roles of the multiple agencies with regulatory responsibilities for protecting the water quality of the St. Johns River. In many ways, these current programs have provided meaningful protection to the public health and fish and wildlife within the basin's environment.

This planning effort is oriented towards the extension of current programs through the identification of means to improve the efficiency and overall effectiveness of basinwide water quality management practices. The interim plan outlines actions already undertaken and methods and needs for improving the water quality information base used for management decisions by the St. Johns River Water Management District and others.

LOCAL ACTIVITIES

Through this investigation, the St. Johns River Water Management District undertook the preparation of a water quality data base. They coordinated local efforts to identify the thirteen agencies which monitor surface and/or ground water quality within the basin. Data collected by these agencies are now being maintained in the District's data base, which essentially is a subset of the U.S. Environmental Protection Agency's STORET system.

Through continued informal coordination procedures, the District is encouraging the standardization of water quality monitoring practices to assure the maximum compatibility and usability of collected data. This activity also has reduced duplication of collection efforts. Review of data entered into the data base has identified significant information gaps. Additionally needed monitoring programs have been documented as parts of this interim plan.

The construction of the District's data base represents an initial step of a necessarily long-term water quality data development process. Some of the more significant problems associated with data obtained and included in this initial data base have been previously presented in this report. In summary, agencies which obtain water quality data utilize procedures suitable for specific agency needs. All agencies also have resource and capability limitations, and these vary widely among the data collection agencies. Most data collection agencies are primarily concerned with obtaining water column data for comparison with State water quality standards. Most agencies are also primarily interested in determining the extent of contamination or pollution that may be associated with point or nonpoint pollution sources. Few agencies have responsibilities or capabilities for determining those proportions of any contaminant that occurs naturally in surface waters as compared to the same contaminant that may appear in point or nonpoint source effluents. Therefore, few agencies presently appear to have any form of program for determining the geochemical bases of ambient water quality in surface waters. Similarly, few agencies are presently conducting relational studies to technically establish those portions of individual water quality constituents that reasonably may be attributable to natural conditions as compared with man-induced conditions.

Because of current agency responsibility and capability limitations, current water quality management planning efforts are being oriented towards the establishment of improved water column data. More complex geochemical related evaluations are presently given secondary consideration by most regulatory agencies. The Water Management District's broader water management responsibilities may permit this agency to gradually incorporate these levels of investigations into its programs, as capabilities evolve and resources permit.

IDENTIFIED CONCERNS AND DATA NEEDS

The following six general areas of water quality management concerns compiled by the St. Johns River Water Management District provide a focus for further data development requirements:

a. Inadequate data monitoring program in the documented problem area of Lake Jessup;

b. Data gaps in parametric monitoring (pesticide data for agricultural areas, trace metals, flow data);

c. Data gaps in biological monitoring (limiting nutrients, lake tropic states, and macrobenthic data);

d. Inadequate information on stormwater runoff problems throughout the basin and concern for the adequacy of current stormwater regulation for achieving water quality goals;

e. Concern for the adequacy of current nutrient waste load allocations; and

f. Inadequacy of available data to permit effective utilization of predictive water quality models.

PROPOSED WATER QUALITY INVESTIGATION PROGRAM

Introduction

The following broad perspective program is proposed as a framework for initially determining ambient water quality conditions in the St. Johns River. In discussions with several water quality specialists during this investigation, it became clear that a broad gap existed between capabilities utilized for determining compliance with State water quality standards and capabilities needed to establish ambient water quality conditions at some locality within the river system. Ambient water quality may be defined as "the undisturbed or natural water quality conditions of a localized area unaffected by outside and unnatural influences." Development of basic information on ambient water quality conditions would require a full range of biogeochemical investigations within localized parts of the river system. The development of such information would represent a next step in the progressive development of environmental knowledge of the river basin. Such evaluation efforts would initiate an ongoing process of determining natural variations of surface water quality within the basin. This effort recognizes the current local agency limitations, and suggests that Federal participation in initial investigation development efforts would accelerate the current Water Management District capability development process.

Management Alternatives

Water quality management practices may be differentiated into two levels of activities. On the first level of effort, management concerns are oriented towards securing from effluent dischargers reasonable compliance with existing State water quality standards. This level of water quality management is basic and will be required as an ongoing effort to assure that man-induced degradation of the environment is minimized. However, this basic and continuing responsibility of regulatory agencies can only remain effective while it is based upon reasonably accurate technical information and a realistic assessment of human activity impacts upon the environment.

The need exists to apply existing physical science knowledge and technological capabilities to the determination of ambient water quality conditions within the river system. Because of the myriad of ongoing biogeochemical actions and reactions occurring continually within the system, this process will require a long timeframe commitment by the Water Management District to the development of fundamental capabilities for this purpose.

The establishment of a basic ambient water quality understanding for the river system would provide a technical basis for determining the proportion of some water contaminant that occurs naturally within the system as compared to man's contribution of that same contaminant. Such information would permit improved technical evaluations of the effectiveneses of current programs. This level of information also would permit the development of more cost-effective pollution control systems and regional water management programs than presently exist.

Evaluation Requirements

The establishment of a technical basis for understanding ambient water quality conditions at any given locality within the St. Johns River would require five general types of evaluations consisting of: (1) hydrodynamics; (2) soils, geology, and groundwater; (3) sediments, benthos, and sessile communities; (4) surface water inflows or effluents from tributary watersheds and areas immediately adjacent to the river; and (5) water column data.

Water column conditions at any locality in the river at any moment in time represent a biogeochemical composite of impacts of the other physical system conditions requiring evaluation. Hydrodynamic evaluations would include weather and climatic analyses to determine the seasonal and storm-related variations in tributary area and watershed discharges that result in normal fluctuations of river water flow. Almost the entire course of the St. Johns River occurs within a valley system where groundwater seepage emerges and flows as surface water. Development of improved information on soils and geology, as these determine the quality of groundwater that becomes seepage surface water flows, is critical for the determination of ambient water quality conditions. While water column conditions vary continually, evaluation of sediments, benthos, and sessile communities provide more stable information suitable for establishing general or long-term ambient water quality conditions. Finally, as surface water from seepage and rainfall moves through areas adjacent to the river, these flows can greatly impact localized river water quality conditions. Tributary area sheet-flow-like distributed discharges to the river are very different from the point-type flows from tributary watersheds with well-defined streams. A long-range program to develop technical knowledge of seasonal variations in flows and companion water qualities from these inflow sources remain to be developed for the river system.

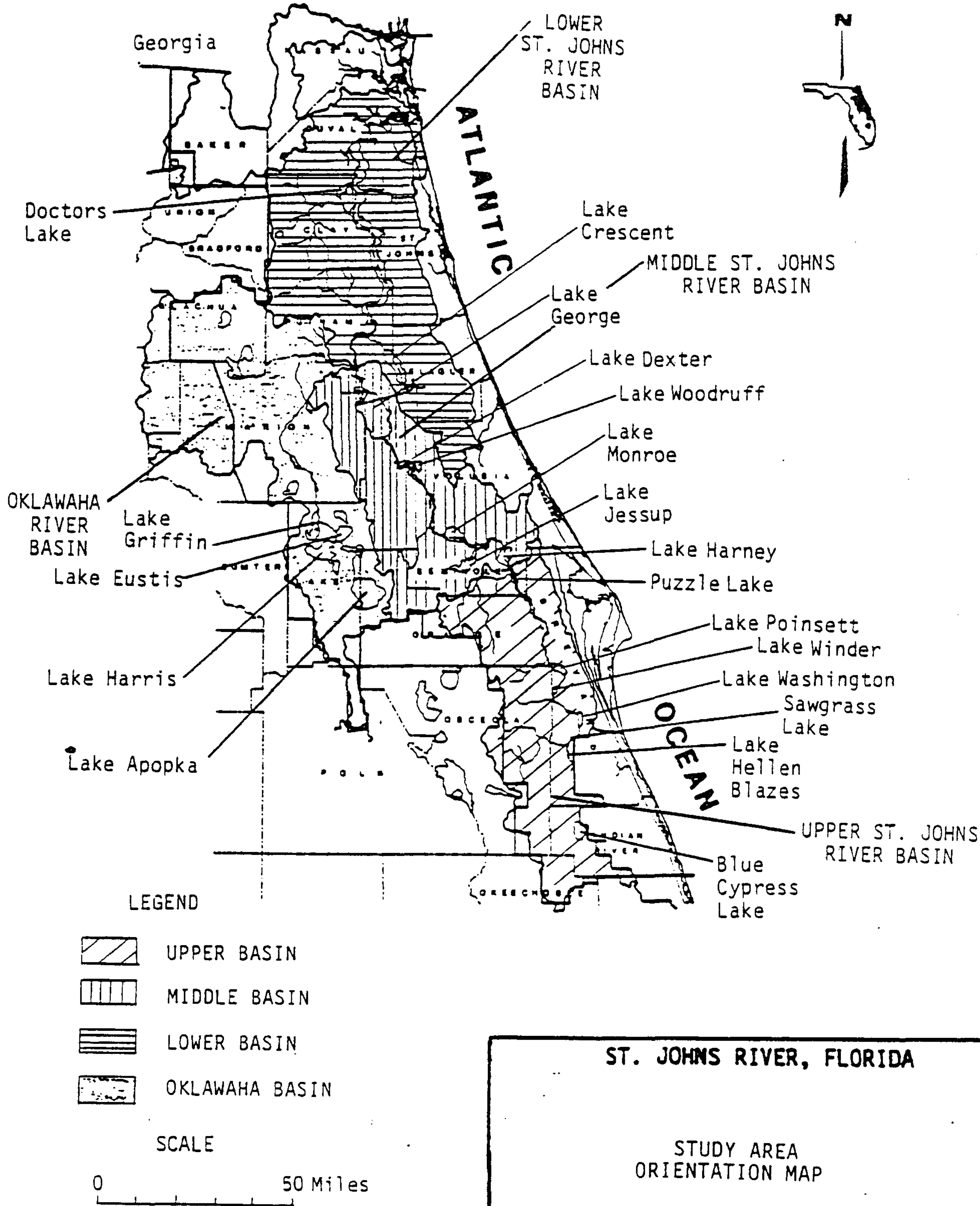
CONCLUSIONS

The Interim Water Quality Management Plan findings present identified concerns and interests of the St. Johns River Water Management District and others. This investigation provided a means for the St. Johns River Water Management District to undertake development of a water quality data base and initiate coordination efforts among agencies with data collection programs within the basin. Improving this data base and extending cooperative efforts among agencies with water quality management responsibilities in the basin are major interests of the District. Construction of such efforts and fuller participation in coordination efforts by all data collection agencies would greatly enhance water quality management efforts within the basin.

While technical specialists have identified an interest in developing ambient water quality information for the St. Johns River, no agreement presently exists with regard to the evaluations that should be undertaken for such purposes. This investigation presents conceptual technical parameters for establishing ambient water quality conditions within the river system. It remains for local interests to determine the appropriateness or need for undertaking actions towards such ends.

Regulatory level endeavors identified by the St. Johns River Water Management District as priority interests have been noted in the Interim Plan findings. These interests appear to be useful additions for augmenting existing District regulatory activities. The District has expressed interest in obtaining Federal assistance to develop some of these types of information.

The scope of local interests regarding single purpose water quality management planning is outside of the traditional Federal authorities provided by Congress to the Corps of Engineers. However, the Corps has technical capabilities for undertaking regional water quality evaluations needed for improved water resources management functions normally conducted within framework of a multi-purpose feasibility study.



ST. JOHNS RIVER, FLORIDA

STUDY AREA
ORIENTATION MAP

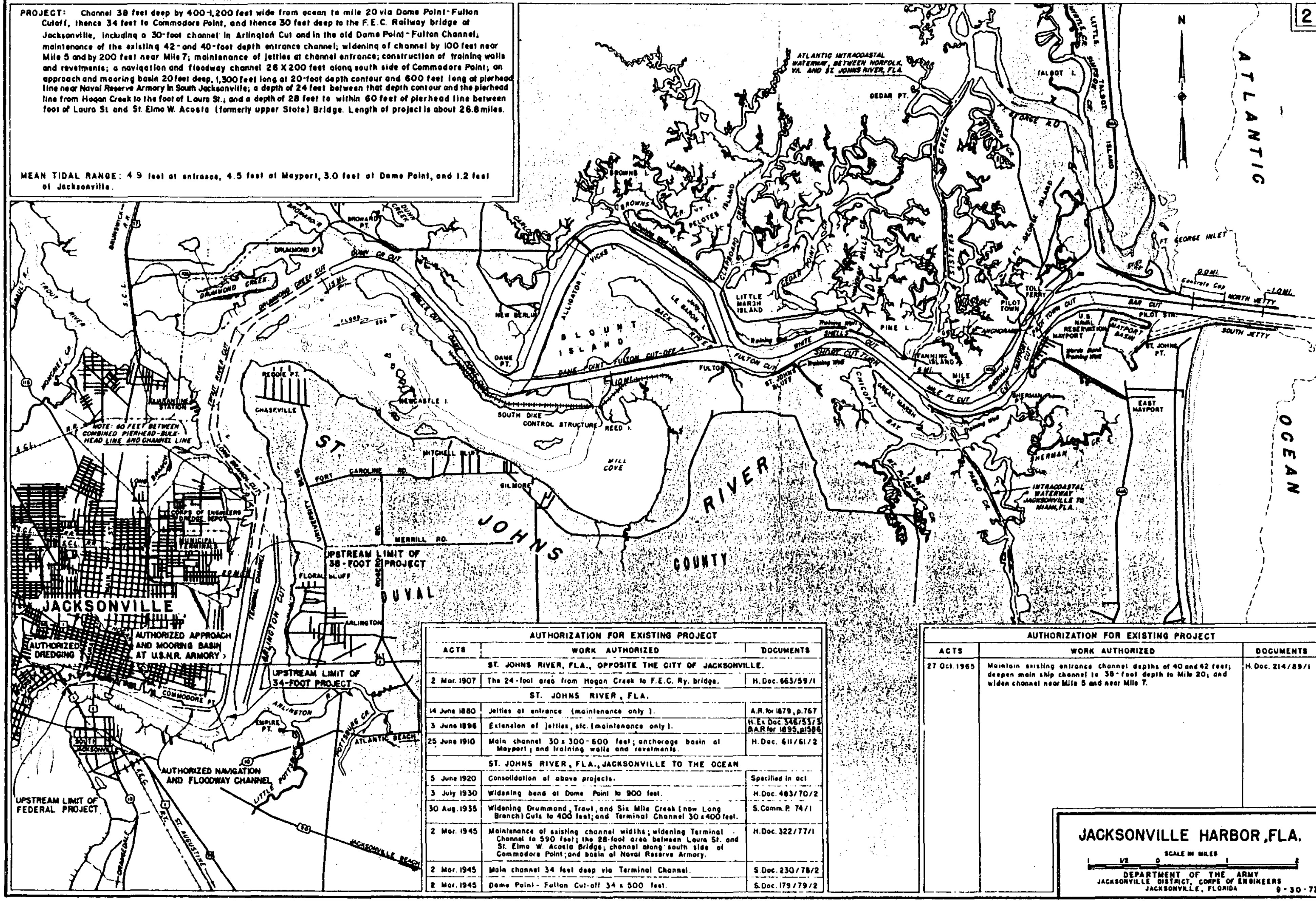
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
DATE:
FILE NO.

PLATE 1

2

PROJECT: Channel 38 feet deep by 400-1,200 feet wide from ocean to mile 20 via Dame Point-Fulton Cutoff, thence 34 feet to Commodore Point, and thence 30 feet deep to the F.E.C. Railway bridge at Jacksonville, including a 30-foot channel in Arlington Cut and in the old Dame Point-Fulton Channel; maintenance of the existing 42- and 40-foot depth entrance channel; widening of channel by 100 feet near Mile 5 and by 200 feet near Mile 7; maintenance of jetties at channel entrance; construction of training walls and revetments; a navigation and floodway channel 26 X 200 feet along south side of Commodore Point; an approach and mooring basin 20 feet deep, 1,300 feet long at 20-foot depth contour and 600 feet long at pierhead line near Naval Reserve Armory in South Jacksonville; a depth of 24 feet between that depth contour and the pierhead line from Hogan Creek to the foot of Laura St.; and a depth of 28 feet to within 60 feet of pierhead line between foot of Laura St. and St. Elmo W. Acosta (formerly upper State) Bridge. Length of project is about 26.8 miles.

MEAN TIDAL RANGE: 4.9 feet at entrance, 4.5 feet at Mayport, 3.0 feet at Dame Point, and 1.2 feet at Jacksonville.



AUTHORIZATION FOR EXISTING PROJECT		
ACTS	WORK AUTHORIZED	DOCUMENTS
	ST. JOHNS RIVER, FLA., OPPOSITE THE CITY OF JACKSONVILLE.	
2 Mar. 1907	The 24-foot area from Hogan Creek to F.E.C. Ry. bridge.	H. Doc. 663/59/1
	ST. JOHNS RIVER, FLA.	
14 June 1880	Jetties at entrance (maintenance only).	A.R. for 1879, p.767
3 June 1896	Extension of jetties, etc. (maintenance only).	H. Ex. Doc. 346/53/3 & A.R. for 1895, p1586
25 June 1910	Main channel 30 x 300-600 feet; anchorage basin at Mayport; and training walls and revetments.	H. Doc. 611/61/2
	ST. JOHNS RIVER, FLA., JACKSONVILLE TO THE OCEAN	
5 June 1920	Consolidation of above projects.	Specified in act
3 July 1930	Widening bend at Dame Point to 900 feet.	H. Doc. 483/70/2
30 Aug. 1935	Widening Drummond, Trout, and Six Mile Creek (now Long Branch) Cuts to 400 feet; and Terminal Channel 30 x 400 feet.	S. Comm. P. 74/1
2 Mar. 1945	Maintenance of existing channel widths; widening Terminal Channel to 590 feet; the 28-foot area between Laura St. and St. Elmo W. Acosta Bridge; channel along south side of Commodore Point; and basin at Naval Reserve Armory.	H. Doc. 322/77/1
2 Mar. 1945	Main channel 34 feet deep via Terminal Channel.	S. Doc. 230/78/2
2 Mar. 1945	Dame Point - Fulton Cut-off 34 x 500 feet.	S. Doc. 179/79/2

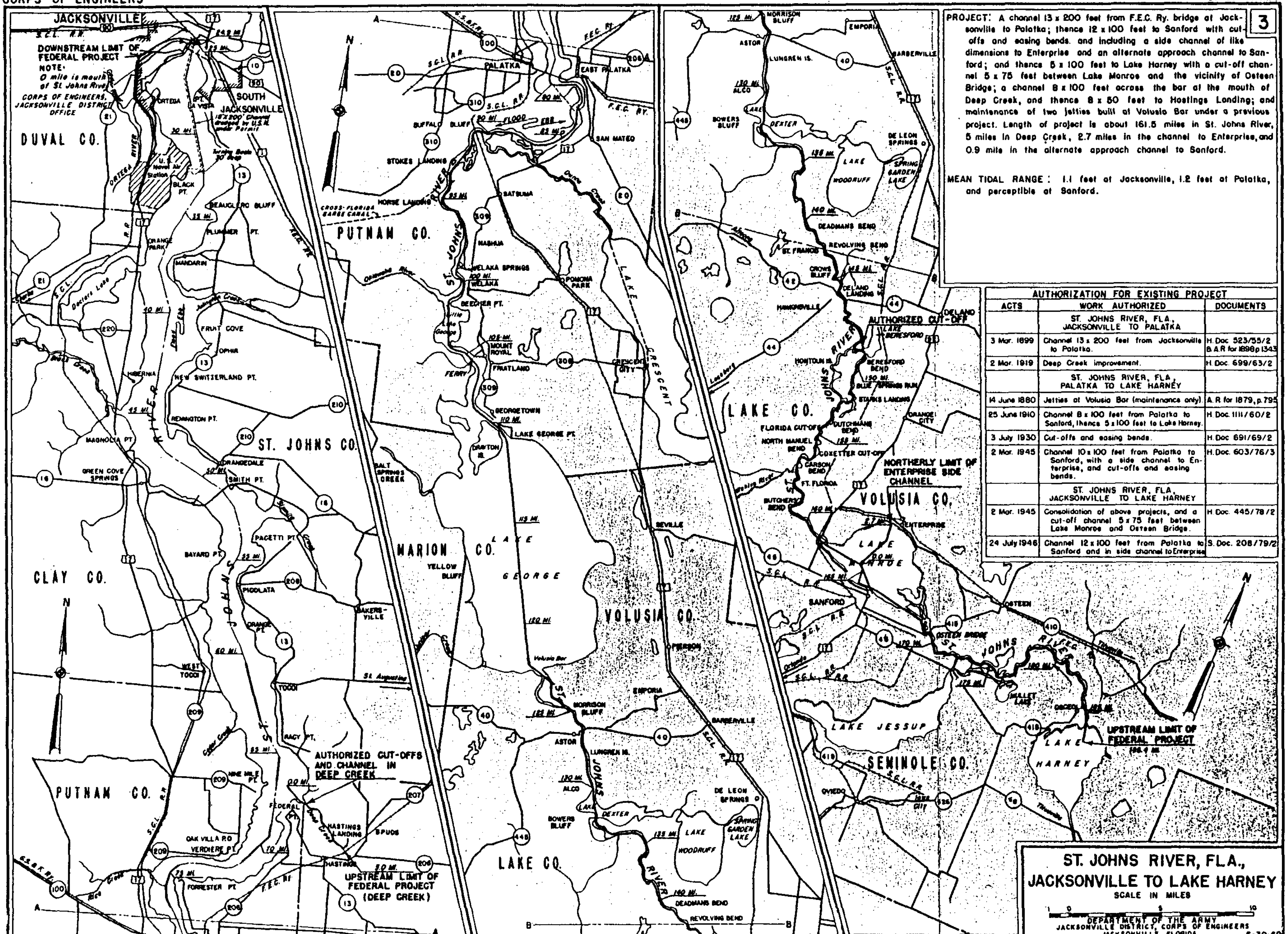
AUTHORIZATION FOR EXISTING PROJECT		
ACTS	WORK AUTHORIZED	DOCUMENTS
27 Oct. 1965	Maintain existing entrance channel depths of 40 and 42 feet; deepen main ship channel to 38-foot depth to Mile 20; and widen channel near Mile 5 and near Mile 7.	H. Doc. 214/89/1

JACKSONVILLE HARBOR, FLA.

SCALE IN MILES

1 1/2 0 1 2

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA 9-30-77



PROJECT: A channel 13 x 200 feet from F.E.C. Ry. bridge at Jacksonville to Palatka; thence 12 x 100 feet to Sanford with cut-offs and easing bends. and including a side channel of like dimensions to Enterprise and an alternate approach channel to Sanford; and thence 5 x 100 feet to Lake Harney with a cut-off channel 5 x 75 feet between Lake Monroe and the vicinity of Osteen Bridge; a channel 8 x 100 feet across the bar at the mouth of Deep Creek, and thence 8 x 50 feet to Hastings Landing; and maintenance of two jetties built at Volusia Bar under a previous project. Length of project is about 161.5 miles in St. Johns River, 5 miles in Deep Creek, 2.7 miles in the channel to Enterprise, and 0.9 mile in the alternate approach channel to Sanford.

3

MEAN TIDAL RANGE: 1.1 feet at Jacksonville, 1.2 feet at Palatka, and perceptible at Sanford.

AUTHORIZATION FOR EXISTING PROJECT

ACTS	WORK AUTHORIZED	DOCUMENTS
	ST. JOHNS RIVER, FLA., JACKSONVILLE TO PALATKA	
3 Mar. 1899	Channel 13 x 200 feet from Jacksonville to Palatka.	H. Doc 523/55/2 B A.R for 1898 p 1343
2 Mar. 1919	Deep Creek improvement.	H. Doc. 699/63/2
	ST. JOHNS RIVER, FLA., PALATKA TO LAKE HARNEY	
14 June 1880	Jetties at Volusia Bar (maintenance only).	A. R for 1879, p. 795
25 June 1910	Channel 8 x 100 feet from Palatka to Sanford, thence 5 x 100 feet to Lake Harney.	H. Doc. 1111/60/2
3 July 1930	Cut-offs and easing bends.	H. Doc 691/69/2
2 Mar. 1945	Channel 10 x 100 feet from Palatka to Sanford, with a side channel to Enterprise, and cut-offs and easing bends.	H. Doc. 603/76/3
	ST. JOHNS RIVER, FLA., JACKSONVILLE TO LAKE HARNEY	
2 Mar. 1945	Consolidation of above projects, and a cut-off channel 5 x 75 feet between Lake Monroe and Osteen Bridge.	H. Doc. 445/78/2
24 July 1946	Channel 12 x 100 feet from Palatka to Sanford and in side channel to Enterprise	S. Doc. 208/79/2

ST. JOHNS RIVER, FLA., JACKSONVILLE TO LAKE HARNEY

SCALE IN MILES

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

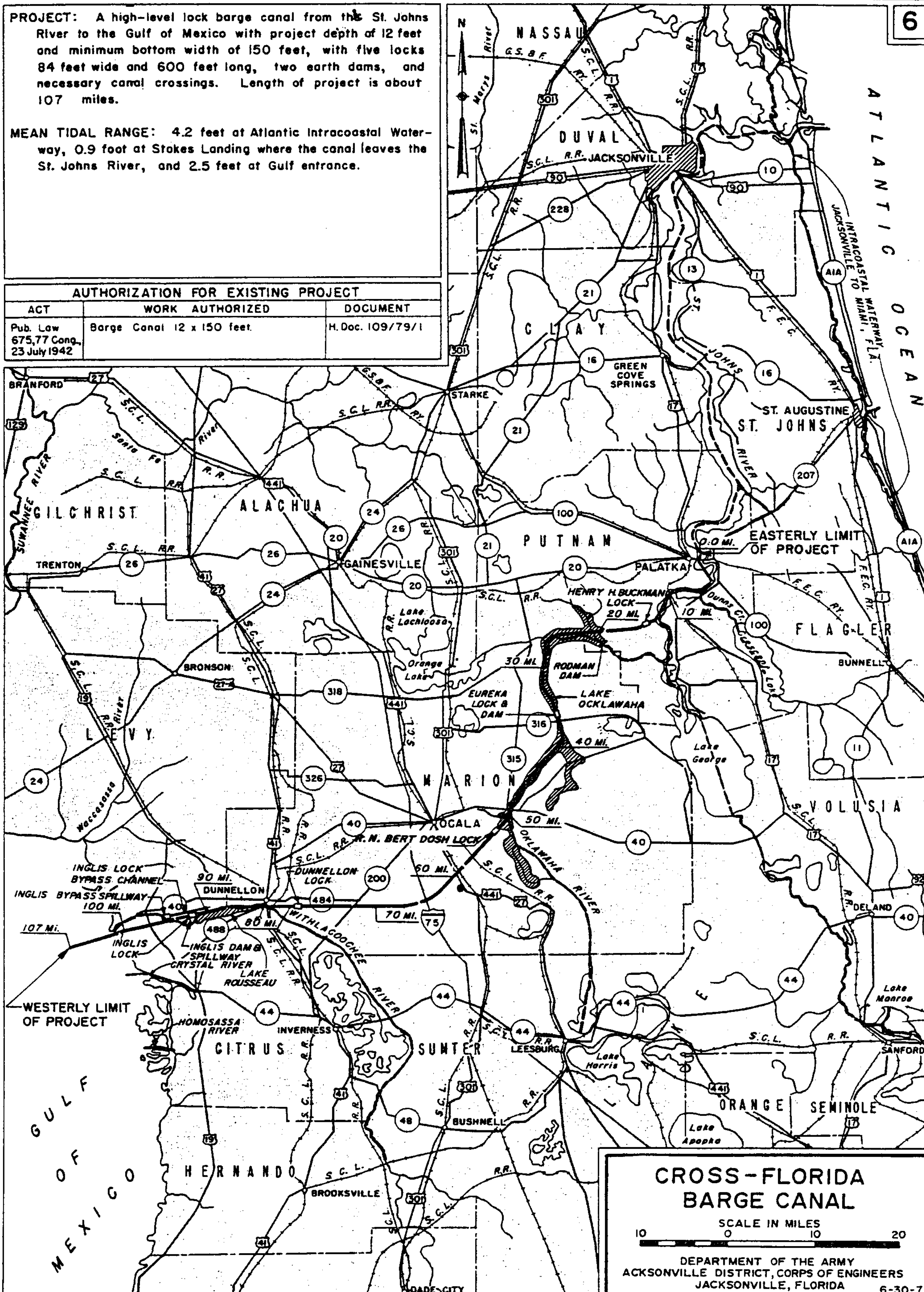
6-30-69

6

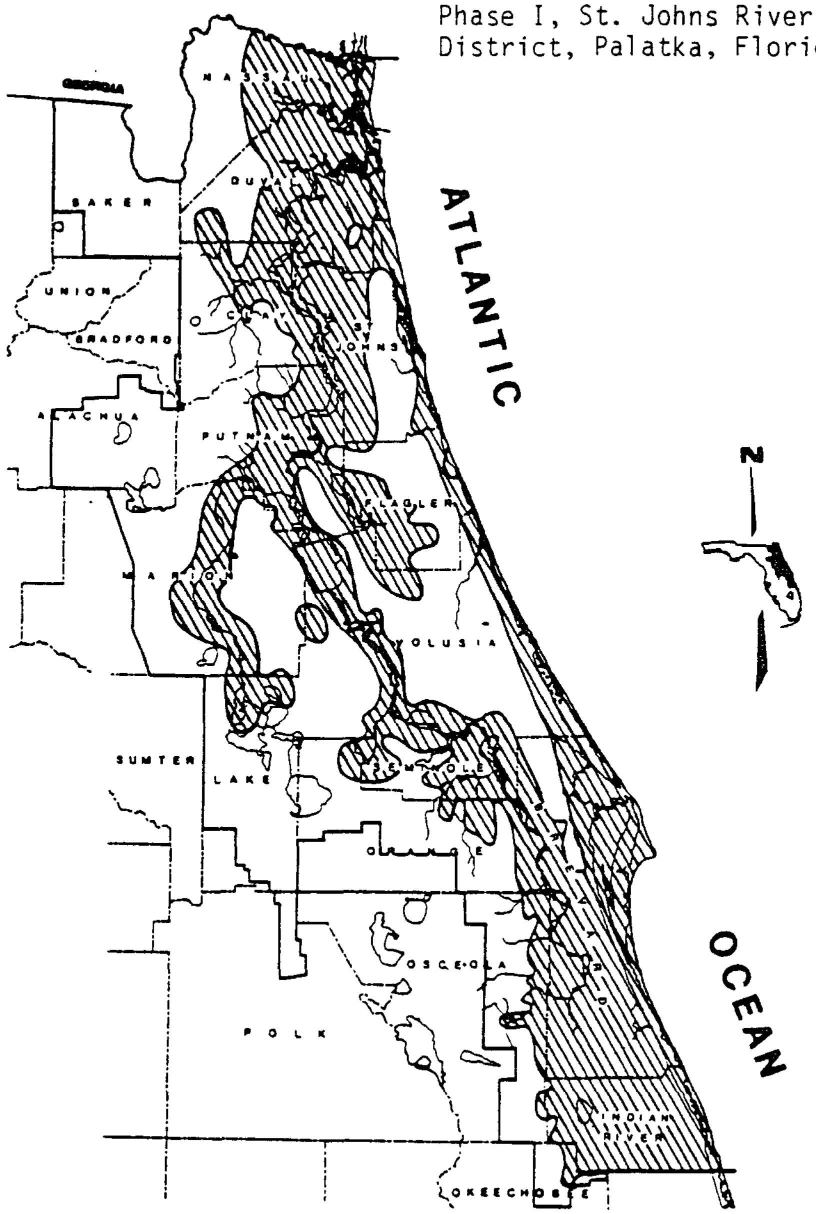
PROJECT: A high-level lock barge canal from the St. Johns River to the Gulf of Mexico with project depth of 12 feet and minimum bottom width of 150 feet, with five locks 84 feet wide and 600 feet long, two earth dams, and necessary canal crossings. Length of project is about 107 miles.

MEAN TIDAL RANGE: 4.2 feet at Atlantic Intracoastal Waterway, 0.9 foot at Stokes Landing where the canal leaves the St. Johns River, and 2.5 feet at Gulf entrance.

AUTHORIZATION FOR EXISTING PROJECT		
ACT	WORK AUTHORIZED	DOCUMENT
Pub. Law 675,77 Cong., 23 July 1942	Barge Canal 12 x 150 feet.	H. Doc. 109/79/1



Source: Water Resource Management Plan, Phase I, St. Johns River Water Management District, Palatka, Florida, November 1977



LEGEND

SJRWMD Boundary

County Boundary

Discharge Area

SCALE

0 50 Miles

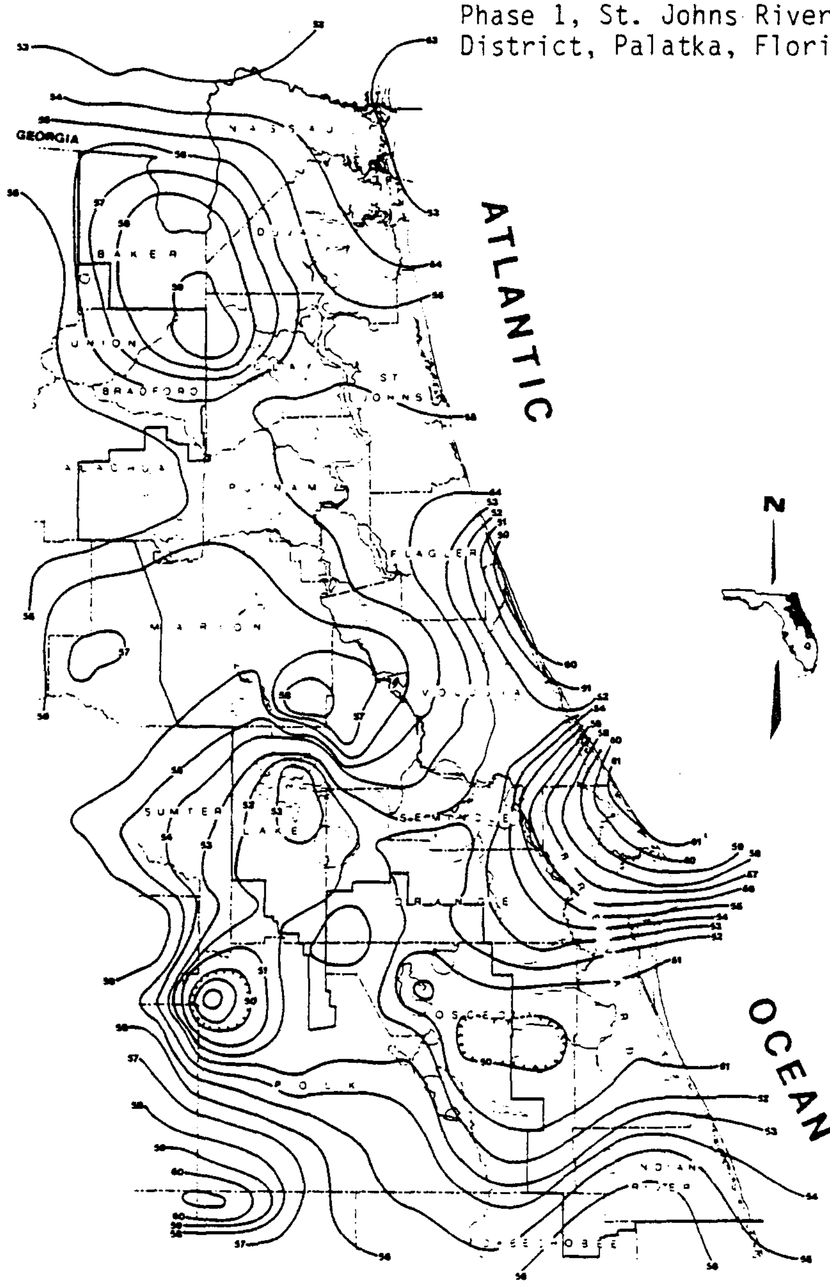
ST. JOHNS RIVER, FLORIDA

GENERALIZED MAP
of
DISCHARGE AREAS

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
DATE:
FILE NO.

PLATE 5

Source: Water Resource Management Plan, Phase 1, St. Johns River Water Management District, Palatka, Florida, November 1977



LEGEND

—50— Mean Annual Rainfall in Inches

SCALE

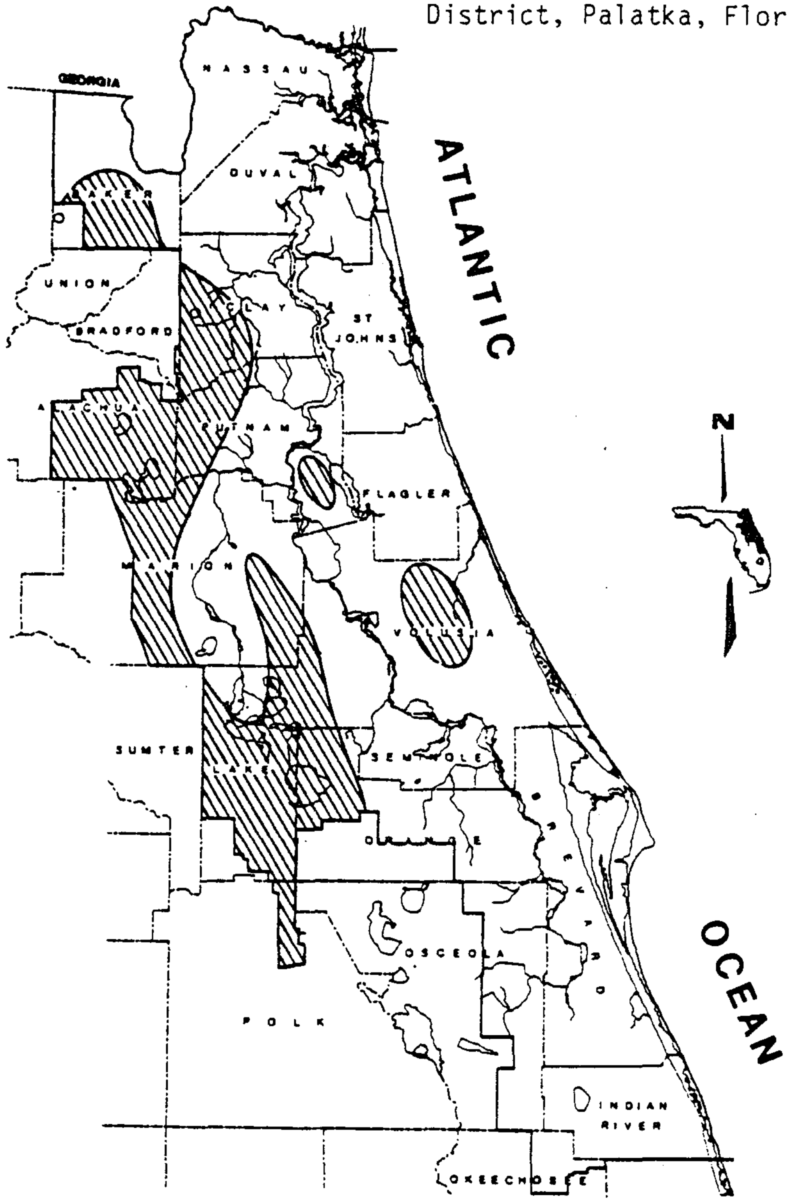
0 50 MILES

ST. JOHNS RIVER, FLORIDA

MEAN ANNUAL RAINFALL 1941 - 1970

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
DATE:
FILE NO.

Source: Water Resource Management Plan, Phase 1, St. Johns River Water Management District, Palatka, Florida, November 1977



LEGEND

—— SJRWMD Boundary

—·— County Boundary

▧ Recharge Area

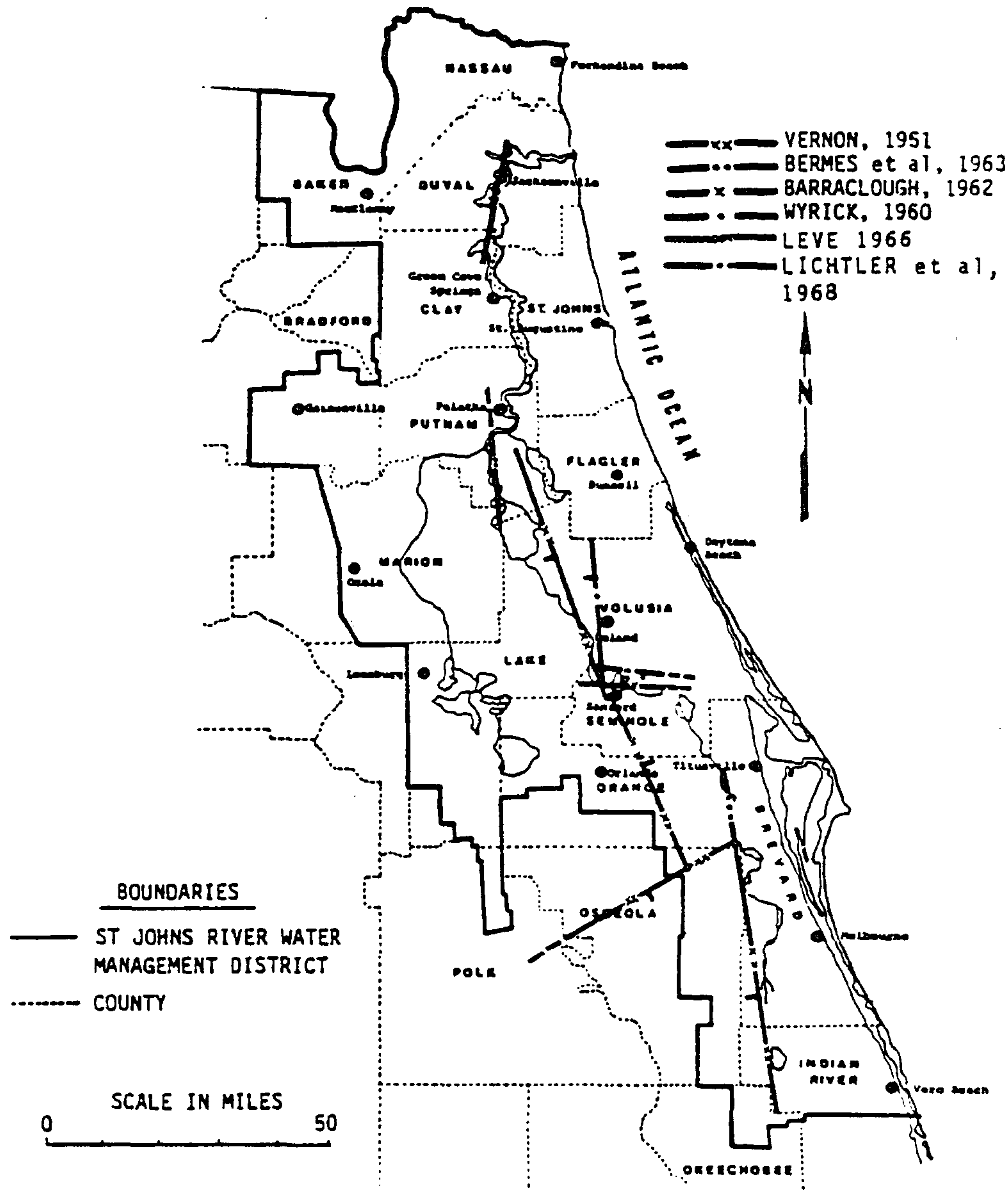
SCALE

0 50 Miles

ST. JOHNS RIVER, FLORIDA

GENERALIZED MAP
of
RECHARGE AREAS

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
DATE:
FILE NO.

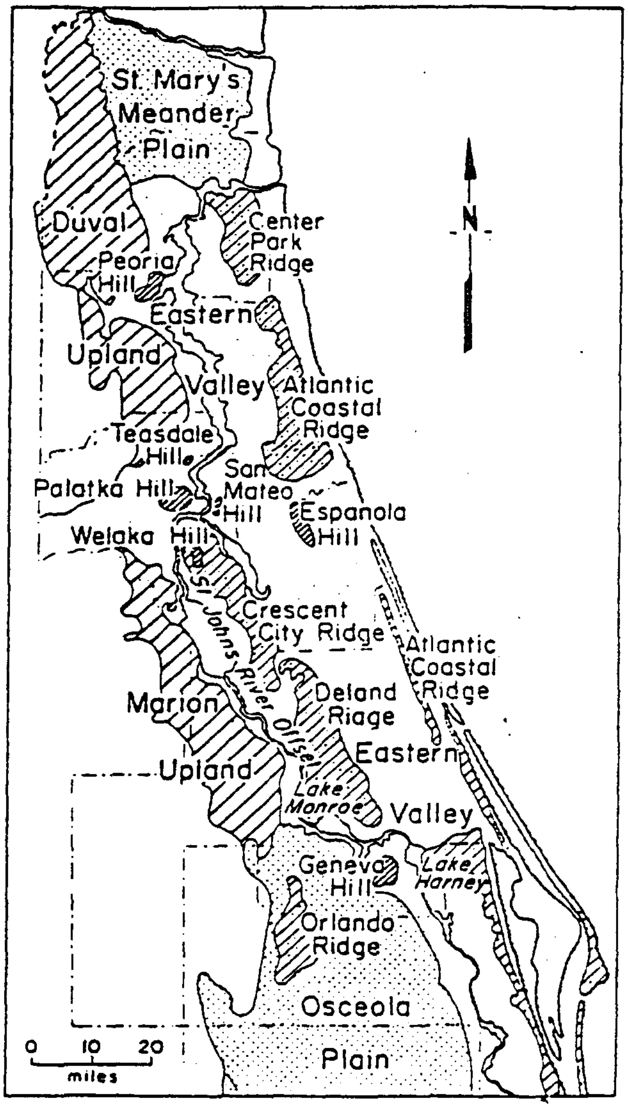


Source: Draft Environmental Impact Statement, Seminole Plant Units 1 and 2 and Associated Transmission Facilities, USDA-REA (ADM) 79-3-D

ST. JOHNS RIVER, FLORIDA

REPORTED FAULTS
ALONG THE
ST. JOHNS RIVER

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
DATE:
FILE NO.



AFTER: PURI AND VERNON, 1964

Source: Draft Environmental Impact Statement, Seminole Plant Units 1 and 2 and Associated Transmission Facilities, USDA-REA (ADM) 79-3-D

ST. JOHNS RIVER, FLORIDA

LANDFORMS IN THE REGION
OF THE
ST. JOHNS RIVER

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
DATE:
FILE NO.

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APPENDIX A

COMMENTS TO INITIAL DRAFT MATERIALS

10-GOV-20-04

ST. JOHNS RIVER
WATER MANAGEMENT DISTRICT

POST OFFICE BOX 1429 • PALATKA, FLORIDA 32078-1429
904/328-8321

May 17, 1985

Mr. Charlie Vigh
U. S. Army Corps of Engineers
P. O. Box 4970
Jacksonville, FL 32232

RE: Comments on draft COE Reconnaissance Report

Dear Mr. Vigh:

As per your request, I am forwarding my comments on the Management Alternatives portion of the draft Reconnaissance Report for the St. Johns River Basin. I appreciate the time and effort you dedicated to completing this report and thank you for an informative document.

The proposed Management Alternatives greatly expand the scope of the project. Since we had hoped to develop an <u>interim</u> water quality management plan, I believe a scaled-down, more problem specific set of alternatives would be appropriate. Therefore, I recommend deleting studies proposed for the St. Johns River between Lake Monroe and Palatka; Soils, Geology and Groundwater Evaluation; Sediment, Benthic and Fossils Evaluations; and Tributary Area Evaluations. Studies on the Lake Harney and Lake Monroe area should be limited to routine monitoring to document the effects of reduced point sources and development of a management plan for Lake Jessup. Studies from Palatka to the Atlantic Ocean should emphasize the addition of parametric monitoring for trace metals and toxic organics to existing sampling networks.

Enclosed is a map which our Division of Engineering uses to plan hydrologic studies. I believe this would be sufficient segmentation for your Hydrodynamic Evaluations. I have recommended that the flow monitoring network be increased and coordinated with water sampling in order to calculate pollutant loads.

I suggest that you add a section encouraging coordination and data exchange between agencies with sampling networks or research projects. The District will maintain the St. Johns River Basin water quality data-base and encourages the participation of other agencies.

I have no comments on the Waterways Usage Review or Lower St. Johns River Enhancement since those were outside the scope of our contract. Please note that my comments are technical and at a staff level. Policy comments concerning local sponsorship or budgeting will be made from an administrative level.

I have found this project to be extremely useful in planning the District's water quality monitoring programs and computer database. I thank you for your assistance and the opportunity to comment on your report.

Sincerely,

CAROL FALL, Environmental Specialist
Division of Environmental Sciences
Water Resources Department

CJF:lab

Enclosure

APPENDIX B

FLORIDA WATER OUALITY STANDARDS

CHAPTER 17-3

FLORIDA RULES OF THE DEPARTMENT OF ENVIRONMENTAL REGULATION

FLORIDA WATER QUALITY STANDARDS

(Florida Rules of the Department of Environmental Regulation, Chapter 17-3 — Water Quality Standards; Adopted October 28, 1970; Amended March 4, 1971; June 10, 1972; August 30, 1972; June 3, 1973; February 12, 1975; August 26, 1975; June 10, 1976; July 13, 1978; October 28, 1978; January 1, 1979; March 1, 1979; March 5, 1980; August 10, 1980; October 2, 1980; July 27, 1981; August 4, 1982; November 5, 1982; November 10, 1982; December 30, 1982; April 26, 1983; January 26, 1984)

CONTENTS

PART I. DECLARATION AND INTENT

17-3.011 FINDINGS, DECLARATION AND INTENT

(1) Article II, Section 7 of the Florida Constitution requires abatement of water pollution, and conservation and protection of Florida's natural resources and scenic beauty.

(2) Section 403.021, Florida Statutes, declares that the public policy of the state is to conserve the waters of the state and to protect, maintain, and improve the quality thereof for public water supplies, for the propagation of wildlife, fish and other aquatic life, and for domestic, agricultural, industrial, recreational, and other beneficial uses. It also prohibits the discharge of wastes into Florida waters without treatment necessary to protect those beneficial uses of the waters.

(3) Congress, in Section 101(a)(2) of the Federal Water Pollution Control Act, as amended, declares that achievement by July 1, 1983, of water quality sufficient for the protection and propagation of fish, shellfish, and wildlife, as well as for recreation in and on the water, is an interim goal to be sought wherever attainable. Congress further states, in Section 101(a)(3), that it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited.

(4) The present and future most beneficial uses of all waters of the State have been designated by the Department by means of the classification system set forth in this Chapter pursuant to 403.061(12), F.S. Water quality standards are established by the Department to protect these designated uses.

(5) Pollution which causes or contributes to new violations of water quality standards or to continuation of existing violations is harmful to the waters of this state and shall not be allowed.

(6) The quality of water which exceeds the minimum quality necessary to support the designated use of those waters shall be protected and enhanced.

(7) The quality of waters which is lower than that necessary to support the designated use of those waters shall be protected and enhanced provided, however, the Department shall not strive to abate natural conditions.

(8) The highest protection shall be afforded to Outstanding Florida Waters.

(9) Because activities outside the State sometimes cause pollution of Florida's waters, the Department will make every reasonable effort to have such pollution abated.

(10) Water quality standards apply equally to and shall be uniformly enforced in both the public and private sector.

(11) The Department finds that excessive nutrients (total nitrogen and total phosphorus) constitute one of the most severe water quality problems facing the state. It shall be the Department policy to limit the introduction of man-induced nutrients into waters of the State. Particular consideration shall be given to the protection from further nutrient enrichment of waters which are presently high in nutrient concentrations and sensitive to further nutrient loadings. Also, particular consideration shall be given to the protection from nutrient enrichment of those waters presently containing very low nutrient concentrations less than 0.3 milligrams per litre (mg/l) total nitrogen or less than 0.04 milligrams per litre (mg/l) total phosphorus.

(12) Public interest shall not be construed to mean only those activities conducted solely to provide facilities or benefits to the general public. Private activities conducted for private purposes may also be in the public interest.

(13) The Commission, recognizing the complexity of water quality management and the necessity to temper regulatory actions with the realities of technological progress and the social and economic wellbeing of peoples, urges, however, that there be no compromise where discharges of pollutants constitute a valid hazard to human health.

(14) The Commission requests that the Secretary seek and use the best environmental information available when making decisions on the effects of chronically and acutely toxic substances and carcinogenic, mutagenic, and teratogenic substances. Additionally, the Secretary is requested to seek and encourage innovative research and developments in waste treatment alternatives that might better preserve environmental quality or at the same time reduce the energy and dollar costs of operation.

(15) The present and future most beneficial uses of groundwaters of the State shall be protected to insure the availability and utility of this invaluable resource. To achieve such protection, the groundwaters of the State are classified and appropriate specific water quality criteria for those classes are set forth in this Chapter.

(16) The criteria set forth in this Chapter are minimum levels which are necessary to protect the designated uses of a water body. It is the intent of this Commission that permit applicants should not be penalized due to a low detection limit associated with any specific criteria.

(17) In adoption of the Outstanding Florida Waters designated on July 13, 1978, the Commission has been assured by the Secretary that adequate public notice has been given that these waters were being considered for this designation and that public comment was solicited and considered in determining their designation.

(18) (a) The revisions made to Chapters 17-3 and 17-4 and the adoption of Chapter 17-6, F.A.C., are designed to protect the public health or welfare and to enhance the quality of waters of the State. They have been established taking into consideration the use and value of waters of the State for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes, and also taking into consideration their use and value for navigation.

(b) Under the approach taken in the formulation of the rules adopted in this proceeding:

1. These revisions to Chapters 17-3, 17-4 and adoption of Chapter 17-6, F.A.C., are based upon the best scientific knowledge related to the protection of the various designated uses of waters of the state; and,

2. The mixing zone, zone of discharge, site specific alternative criteria, exemption, and equitable allocation provisions are designed to provide an opportunity for the future consideration of factors relating to localized situations which could not adequately be addressed in this proceeding, including economic and social consequences, attainability, irretrievable conditions, natural background, and detectability.

(c) This is an even-handed and balanced approach to attainment of water quality objectives. The Commission has specifically recognized that the social, economic and environmental costs may, under certain special circumstances, outweigh the social, economic and environmental benefits if the numerical criteria are enforced statewide. It is for that reason that the Commission has provided for mixing zones, zones of discharge, site specific alternative criteria, exemptions and other provisions in Chapters 17-3, 17-4, and 17-6. Furthermore, the continued availability of the moderating provisions is a vital factor providing a basis for the Commission's determination that water quality standards applicable to water classes in the rule are attainable taking into consideration environmental, technological, social, economic and institutional factors. The companion provisions of Chapters 17-4 and 17-6 approved simultaneously with these Water Quality Standards are incorporated herein by reference as a substantive part of the State's comprehensive program for the control, abatement and prevention of water pollution.

(d) Without the moderating provisions described in (b)2 above, the Commission would not have adopted the revisions described in (b)1 above nor determined that they are attainable as generally applicable water quality standards.

PART II DEFINITIONS

17-3.021 DEFINITIONS

(1) "Acute Toxicity" shall mean the presence of one or more substances or characteristics or components of substances in amounts which:

(a) are greater than one-third (1/3) of the amount lethal to 50% of the test organisms in 96 hours (96 hr LC_{50}) where the 96 hr LC_{50} is the lowest value which has been determined for a species significant to the indigenous aquatic community; or

(b) may reasonably be expected, based upon evaluation by generally accepted scientific methods, to produce effects equal to those of the concentration of the substance specified in (a) above.

(2) "Background" shall mean the condition of waters in the absence of the activity or discharge under consideration, based on the best scientific information available to the Department.

(3) "Chronic Toxicity" shall mean the presence of one or more substances or characteristics or components of substances in amounts which:

(a) are greater than one-twentieth (1/20) of the amount lethal to 50% of the test organisms in 96 hours (96 hr LC_{50}) where the 96 hr LC_{50} is the lowest value which has been determined for a species significant to the indigenous aquatic community; or

(b) may reasonably be expected, based upon evaluation by generally accepted scientific methods, to produce effects equal to those of the concentration of the substance specified in (a) above.

(4) "Commission" shall mean the Environmental Regulation Commission.

(5) "Compensation Point for Photosynthetic Activity" shall mean the depth at which one percent of the light intensity at the surface remains unabsorbed. The light intensities at the surface and subsurface shall be measured simultaneously by irradiance meters such as the Kahlsico Underwater Irradiameter, Model No. 268 WA 310 or other devices having a comparable spectral response.

(6) "Department" shall mean the Department of Environmental Regulation.

(7) "Designated Use" shall mean the present and future most beneficial use of a body of water as designated by the Environmental Regulation Commission by means of the classification system contained in this Chapter.

(8) "Dominance" shall mean the presence of species or communities in greater numbers, biomass, or areal extent than competing species or communities, or a scientifically accepted tendency of species or communities to achieve such a status under existing or reasonably anticipated conditions.

(9) "Effluent Limitation" shall mean any restriction established by the Department on quantities, rates or concentrations of chemical, physical, biological or other constituents which are discharged from sources into waters of the state.

(10) "Exceptional Ecological Significance" shall mean that a water body is a part of an ecosystem of unusual value. The exceptional significance may be in unusual species, productivity, diversity, ecological relationships, ambient water quality, scientific or educational interest, or in other aspects of the ecosystem's setting or processes.

(11) "Exceptional Recreational Significance" shall mean unusual value as a resource for outdoor recreation activities. Outdoor recreation activities include, but are not limited to, fishing, boating, canoeing, water skiing, swimming, scuba diving, or nature observation. The exceptional significance may be in the intensity of present recreational usage, in an unusual quality of recreational experience, or in the potential for unusual future recreational use or experience.

(12) "Ground water" means water beneath the surface of the ground within a zone of saturation, whether or not flowing through known and definite channels.

(13) "Man-induced conditions which cannot be controlled or abated" shall mean conditions that have been influenced by human activities, and

(a) would remain after removal of all point sources,

(b) would remain after imposition of best management practices for non-point sources, and

(c) cannot be restored or abated by physical alteration of the water body, or there is no reasonable relationship between the economic, social and environmental costs and the benefits of restoration or physical alteration.

(14) "Natural Background" shall mean the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department.

(15) "Nuisance Species" shall mean species of flora or fauna whose noxious characteristics or presence in sufficient number, biomass, or areal extent may reasonably be expected to prevent, or unreasonably interfere with, a designated use of those waters.

(16) "Nursery Area of Indigenous Aquatic Life" shall mean any bed of the following aquatic plants, either in monoculture or mixed: Haloduie spp., Halophila Engelmannii, Potamogeton spp., (pondweed), Ruppia maritima, (widgeon-grass), Sagittaria spp. (arrowhead), Syringodium filiforme, (manatee-grass), Thallasia testudinum (turtle grass), or Vallisneria spp., (eel-grass), or any area used by the early-life stages, larvae and post-larvae, of aquatic life during the period of rapid growth and development into the juvenile stages.

(17) "Pollution" shall mean the presence in the outdoor atmosphere or waters of the state of any substances, contaminants, noise, or man-made or man-induced alteration of the chemical, physical, biological or radiological integrity of air or water in quantities or levels which are or may be potentially harmful or injurious to human health or welfare, animal or plant life, or property, including outdoor recreation.

(18) "Predominantly Fresh Waters" shall mean surface waters in which the chloride concentration at the surface is less than 1,500 milligrams per liter.

(19) "Predominantly Marine Waters" shall mean surface waters in which the chloride concentration at the surface is greater than or equal to 1,500 milligrams per liter.

(20) "Propagation" shall mean reproduction sufficient to maintain the species' role in its respective ecological community.

(21) "Secretary" shall mean the Secretary of the Department of Environmental Regulation.

(22) "Shannon-Weaver Diversity Index" shall mean: negative summation (i=1 to s) of $(n_i/N) \log_2 (n_i/N)$ where s is the number of species in a sample, N is the total number of individuals in a sample and n_i is the total number of individuals in species i.

(23) "Special Waters" shall mean water bodies designated in accordance with 17-3.041 by the Environmental Regulation Commission for inclusion in the Special Waters Category of Outstanding Florida Waters, as contained in Section 17-3.041, Florida Administrative Code. A Special Water may include all or part of any water body.

(24) "Surface Water" means water upon the surface of the earth, whether contained in bounds created naturally or artificially or diffused. Water from natural springs shall be classified as surface water when it exits from the spring onto the earth's surface.

(25) "Waters" shall be as defined in Section 403.031(3), Florida Statutes.

(26) "Zone of Discharge" shall mean a volume underlying surrounding the site and extending to the base of a specifically designated aquifer or aquifers, within which an opportunity for the treatment, mixture or dispersion of wastes into receiving ground water is afforded.

(27) "Zone of Mixing" shall mean a volume of surface water containing the point or area of discharge and within which an opportunity for the mixture of wastes with receiving surface waters has been afforded.

(28) "Zone of Saturation" shall mean a subsurface zone in which all of the interstices are filled with water.

(29) "Single source aquifer" shall mean an aquifer or a portion of an aquifer which, pursuant to Sections 17-3.403(5) & (6), F.A.C., is determined by the Commission to be the only reasonably available source of potable water to a significant segment of the population.

(30) "Site" shall mean the area within an installation's property boundary where effluents are released or applied to the ground water.

(31) Confined Aquifer" shall mean an aquifer bounded above and below by impermeable beds or by beds of distinctly lower permeability than that of the aquifer itself.

(32) "Unconfined Aquifer" shall mean an aquifer other than a confined aquifer.

(33) "Aquifer" shall mean a geologic formation, group of formations, or part of a formation capable of yielding a significant amount of ground water to wells, springs or surface water.

PART III WATER QUALITY CRITERIA — SURFACE WATER

17-3.031 SITE SPECIFIC ALTERNATIVE CRITERIA.

(1) A water body, or portion thereof, may not meet a particular ambient water quality criterion specified for its classification, due to natural background conditions or man-induced conditions which cannot be controlled or abated. In such circumstances, and upon petition by an affected person or upon the initiation by the Department, the Secretary may establish a site specific alternative water quality criterion when an affirmative demonstration is made that an alternative criterion is more appropriate for a specified portion of waters of the state. Public notice and an opportunity for public hearing shall be provided prior to issuing any order establishing alternative criteria.

(2) The affirmative demonstration required by this section shall mean a documented showing that the proposed alternative criteria would exist due to natural background conditions or man-induced conditions which cannot be controlled or abated. Such demonstration shall be based upon relevant factors which include:

(a) A description of the physical nature of the specified water body and the water pollution sources affecting the criterion to be altered.

(b) A description of the historical and existing water quality of the parameter of concern including, spatial, seasonal, and diurnal variations, and other parameters or conditions which may affect it. Conditions in similar water bodies may be used for comparison.

(c) A description of the historical and existing biology, including variations, which may be affected by the parameter of concern. Conditions in similar water bodies may be used for comparison.

(d) A discussion of any impacts of the proposed alternative criteria on the designated use of the waters and adjoining waters.

(3) The Secretary shall specify, by order, only those criteria which the Secretary determines to have been demonstrated by the preponderance of competent substantial evidence to be more appropriate.

(4) The Department shall modify permits of existing sources affected by the exception in a manner consistent with the Secretary's Order.

(5) Additional relief from criteria established by this Chapter may be provided through exemption pursuant to Section 17-4.243, Florida Administrative Code, or variances as provided for by Section 17-1.57, Florida Administrative Code.

17-3.041 SPECIAL PROTECTION, OUTSTANDING FLORIDA WATERS

(1) It shall be the Department policy to afford the highest protection to Outstanding Florida Waters (a complete listing of which is provided in subsection (3)) which generally include the following surface waters:

(a) waters in National Parks, Wildlife Refuges, and Wilderness Areas; and

(b) waters in the State Park System and Wilderness Areas; and

(c) waters within areas purchased under the Environmentally Endangered Lands Bond Program or the Conservation and Recreation Lands Program: and

(d) rivers designated under the Florida Scenic and Wild Rivers Program or the National Wild and Scenic Rivers Act: and

(e) waters within National Seashores, National Marine Sanctuaries, National Estuarine Sanctuaries, and certain National Monuments: and

(f) waters in Aquatic Preserves, created under the provisions of Chapter 258, Florida Statutes: and

(g) waters within the Big Cypress National Freshwater preserve: and

(h) Special Waters as listed in 17-3.041(4)(i).

(2) Each water body demonstrated to be of exceptional recreational or ecological significance may be designated as a Special Water. The following procedure shall be used in designating a Special Water after the adoption of this rule:

(a) Rulemaking procedures pursuant to Chapter 120, F.S., and Chapter 17-1 shall be followed:

(b) At least one fact-finding workshop shall be held in the affected area:

(c) All local county or municipal governments and state legislators whose districts or jurisdictions include all or part of a special water shall be notified at least 60 days prior to the workshop in writing by the Secretary:

(d) A prominent public notice shall be placed in a newspaper of general circulation in the area of the proposed Special Water at least 60 days prior to the workshop:

(e) An economic impact analysis, consistent with Chapter 120, shall be prepared which provides a general analysis of the impact on growth and development including such factors as impacts on planned or potential industrial, agricultural, or other development or expansion: and

(f) The Commission may designate a water of the State as a Special Water after making a finding that the waters are of exceptional recreational or ecological significance and a finding that the environmental, social, and economic benefits of the action outweigh the environmental, social, and economic costs.

(3) The policy of this section shall be implemented through the permitting process pursuant to Section 17-4.242.

(4) Outstanding Florida Waters:

(a) Waters within National Parks

National Park — County

Biscayne — Dade

Everglades — Monroe/Dade/Collier

(b) Waters within National Wildlife Refuges

Wildlife Refuge — County

Caloosahatchee — Lee
Cedar Keys — Levy
Chassahowitzka — Citrus/Hernando
Chinsegut — Hernando
Crocodile Lake — Monroe
Egmont Key — Hillsborough
Great White Heron — Monroe
Hobe Sound — Martin
Island Bay — Charlotte
J.N. "Ding" Darling — Lee
Key West — Monroe
Lake Woodruff — Volusia/Lake
Lower Suwanne — Dixie
Loxahatchee — Palm Beach
Matlacha Pass — Lee
Merritt Island — Volusia/Brevard
National Key Deer — Monroe
Okefenokee (Florida Portion) — Baker
Passage Key — Manatee
Pelican Island — Indian River
Pig Island — Gulf
Pine Island — Lee
Pinellas — Pinellas
St. Johns — Brevard
St. Marks — Jefferson/Wakulla
St. Vincent — Franklin

(c) Waters within State Parks or Recreation Areas

State Park or Recreation Area — County

Anastasia State Recreation Area — St. John's
Bahia Honda State Recreation Area — Monroe
Basin Bayou State Recreation Area — Walton
Bear Creek State Recreation Area — Gadsden
Big Lagoon State Recreation Area — Escambia
Bill Baggs Cape Florida State Recreation Area — Dade
Blackwater River State Park — Santa Rosa
Blue Springs State Park — Volusia
Caladesi Island State Park — Pinellas
Caloosahatchee River State Recreation Area — Lee
Chekika State Recreation Area — Dade
Collier-Seminole State Park — Collier
Dead Lakes State Recreation Area — Gulf
Delnor-Wiggins Pass State Recreation Area — Collier
Dr. Julian G. Bruce St. George Island State — Franklin
Falling Waters State Recreation Area — Washington
Faver-Dykes State Park — St. John's
Flagler Beach State Recreation Area — Flagler
Florida Caverns State Park — Jackson
Fort Clinch State Park — Nassau
Fort Cooper State Park — Citrus
Fort Pierce Inlet State Recreation Area — St. Lucie
Fred Gannon Rocky Bayou State Recreation Area — Okaloosa

Grayton Beach State Recreation Area — Walton
Highlands Hammock State Park — Highlands/Hardee
Hillsborough River State Park — Hillsborough
Honeymoon Island State Recreation Area — Pinellas
Hontoon Island State Park — Volusia/Lake
Hugh Taylor Birch State Recreation Area — Broward
Ichetucknee Springs State Park — Columbia/Suwannee
John D. McArthur Beach State Recreation Area — Palm Beach
John Pennekamp Coral Reef State Park — Monroe
John U. Lloyd Beach State Recreation Area — Broward
Jonathan Dickinson State Park — Martin
Lake Griffin State Recreation Area — Lake
Lake Kissimmee State Park — Polk
Lake Louisa State Park — Lake
Lake Manatee State Recreation Area — Manatee
Lake Rousseau State Recreation Area — Citrus/Levy/Marion
Lake Talquin State Recreation Area — Leon/Gadsden/Liberty
Little Manatee River State Recreation — Hillsborough
Little Talbot Island State Park — Duval
Long Key State Recreation Area — Monroe
Manatee Springs State Park — Levy
Mike Roess Gold Head Branch State Park — Clay
Myakka River State Park — Manatee/Sarasota
Ochlockonee River State Park — Wakulla
O'Leno State Park — Alachua/Columbia
Oleta River State Recreation Area — Dade
Oscar Scherer Recreation Area — Sarasota
Pahokee State Recreation Area — Palm Beach
Palm Beach Pines State Recreation Area — Palm Beach
Pepper Beach State Recreation Area — St. Lucie
Ponce de Leon Springs State Recreation Area — Holmes/Walton
Port Charlotte Beach State Recreation Area — Charlotte
St. Andrews State Recreation Area — Bay
St. Lucie Inlet State Park — Martin
Sebastian Inlet State Recreation Area — Hamilton/Madison/Swuannee
Three Rivers State Recreation Area — Jackson
T.H. Stone Memorial St. Joseph Peninsula State Park — Gulf
Tomoka State Park — Volusia
Torreya State Park — Liberty
Wekiwa Springs State Park — Orange/Seminole

(d) Waters within State Ornamental Gardens

State Ornamental Garden — County
Alfred B. Maclay State Gardens — Leon
Eden State Gardens — Walton
Ravine State Gardens — Putnam
Washington Oaks State Gardens — Flagler

(e) Waters within State Preserves

State Preserve — County
Anclote Key State Preserve Pasco/Pinellas
Barefoot Beach State Preserve — Collier
Cape St. George State Preserve — Franklin
Cayo Costa State Preserve — Lee
Cedar Key Scrub State Preserve — Levy
Fakahatchee Strand State Preserve — Collier
Haw Creek State Preserve — Flagler/Putnam/Volusia
Lower Wekiva River State Preserve — Lake/Seminole
Paynes Prairie State Preserve — Alachua
Perdido Key State Preserve — Escambia
Prairie-Lakes State Preserve — Osceola
River Rise State Preserve — Alachua/Columbia
San Felasco Hammock State Preserve — Alachua
Savannas State Preserve — Martin/St. Lucie
Tosohatchee State Preserve — Orange
Waccasassa Bay State Preserve — Levy
Weedon Island State Preserve — Pinellas

(f) Waters Within Areas Purchased Under the Environmentally Endangered Lands Bond Program.

Environmentally Endangered Lands — County
Barefoot Beach — Collier
Cayo Costa North Captiva Islands State Preserve — Lee
Cedar Key Scrub — Levy
Charlotte Harbor — Charlotte
Fakahatchee Strand — Collier
Little St. George Island — Franklin
Lower Apalachicola River Basin — Franklin/Gulf
Lower Wekiva River Corridor — Lake/Seminole
Nassau Valley Marshes — Duval/Nassau
Palm Beach County Everglades (Rotenberger) Tract — Palm Beach
Paynes Prairie State Preserve Addition — Alachua
Perdido Key — Escambia
River Rise (McLeod Ranch) — Alachua/Columbia
San Felasco Hammock — Alachua
Savannas — Martin/St. Lucie
Three Lakes Ranch — Osceola
Tosahatchee Preserve — Orange
Volusia Water Recharge Area — Volusia
Weedon Island — Pinellas
Withlacoochee Tracts — Sumter

(g) Waters Within National Seashores

National Seashores — County
Canaveral — Brevard/Volusia
Gulf Islands — Escambia/Santa Rosa

(h) Water Within State Aquatic Preserves

Aquatic Preserves — County

Aligator Harbor — Franklin
Apalachicola Bay — Franklin
Banana River — Brevard
Biscayne Bay — Dade/Monroe
Biscayne Bay-Cape Florida to Monroe County Line — Dade
Boca Ciega Bay — Pinellas
Caladesi Island — Pinellas
Cape Haze — Charlotte/Lee
Cape Romano-Ten Thousand Islands — Collier
Cockroach Bay — Hillsborough
Coupon Bight — Monroe
Estero Bay — Lee
Fort Clinch State Park — Nassau
Fort Pickens State Park — Santa Rosa/Escambia
Gasparilla Sound-Charlotte Harbor — Charlotte/Lee
Indian River Malabar to Sebastian — Brevard/Indian River
Indian River Vero Beach to Ft. Pierce — Indian River/St. Lucie
Jensen Beach to Jupiter Inlet — Martin/Palm Beach/St. Lucie
Lake Jackson — Leon
Lignumvitae Key — Monroe
Loxahatchee River-Lake Worth Creek — Martin/Palm Beach
Matlacha Pass — Lee
Mosquito Lagoon — Volusia/Brevard
Nassau River-St. Johns River Marshes — Nassau/Duval
North Fork, St. Lucie — St. Lucie/Martin
Pellicer Creek — St. Johns/Flagler
Pine Island Sound — Lee
Pinellas County — Pinellas
Rocky Bayou State Park — Okaloosa
Rookery Bay — Collier
St. Andrews State Park — Bay
St. Joseph Bay — Gulf
St. Martin's Marsh — Citrus
Tomoka Marsh — Volusia/Flagler
Wekiva River — Lake/Orange/Seminole
Yellow River Marsh — Santa Rosa

(i) Special Waters

Special Waters

Apalachicola River south of northern Gulf County Line
Aucilla River
Blackwater River
Butler Chain of Lakes — consisting of Lake Butler, Lake Down, Wauseon Bay, Lake Louise, Lake Palmer (also known as Lake Isleworth), Lake Chase, Lake Tibet, Lake Sheen, Pocket Lake, Fish Lake, and the waterways which connect these lakes
Chipola River
Choctawhatchee River
Crystal River, including Kings Bay
Little Manatee River — from its mouth to the western crossing of the river by S.R. 674, including Hayes, Mill and
Bolster Bayous, but excluding South Fork, Ruskin Inlet and all other tributaries.
Ochlockonee River
Perdido River
St. Marks River-except that part between Rattlesnake Branch and the confluence of the St. Marks and Wakulla Rivers.
Shoal River
Suwanne River
Wacissa River
Wakulla River
Wekiva River — south of S.R. 46, including Rock Springs Run and the Little Wekiva River south to its confidence with the northernmost run of Sanlando Springs, but excluding all other tributaries.

(j) Waters Within Rivers Designated Under the Florida Scenic and Wild Rivers Program

Scenic and/or Wild River Segment — County
Wekiva Wild River Segment (12-1-81) — Lake/Seminole

(k) Waters Within National Preserves

National Preserve — County
Big Cypress National Preserve — Collier/Dade/Monroe

(l) Waters Within National Marine Sanctuaries

Marine Sanctuaries — County

Key Largo Coral Reef — Dade
Love Key — Monroe

(m) Waters Within National Estuarine Sanctuaries

National Estuarine Sanctuaries — County

Apalachicola Bay — Franklin
Rookery Bay — Collier

(n) Certain Waters Within the Boundaries of the National Forests

National Forest — County
Apalachicola — Leon/Franklin
Sopchoppy River
Big Dismal Sink
Oscala — Putnam/Marion/Lake
Alexander Springs
Alender Springs Creek
Juniper Springs
Juniper Creek
Salt Springs
Salt Springs Run
Lake Door
Lake Kerr
Little Lake Kerr
Osceola — Baker/Columbia
Deep Creek
Robinson Creek
Middle Prong — St. Mary's River
Ocean Pond
Falling Creek

(5) The effective date of the Outstanding Florida Water designation for waters listed above shall be March 1, 1979, unless otherwise indicated.

17-3.05 THERMAL SURFACE WATER CRITERIA

(1) All discharges or proposed discharges of heated water into receiving bodies of water (RBW) which are controlled by the state shall be subjected to a thorough study to assess the consequences of the discharge upon the environment. The state shall be divided into two general climatological zones: Peninsular Florida, which varies from tropical in nature to temperate but is modified by the peninsular configuration and is the area south of latitude 30 degrees N (excluding Gulf and Franklin Counties); and Northern Florida which is temperate and continental and is the area above latitude 30 degrees N plus the portions of Guld and Franklin Counties which lie below 30 degrees N.

(a) Heated water discharges existing on July 1, 1972:

1. Shall not increase the temperature of the RBW so as to cause substantial damage or harm to the aquatic life or vegetation therein or interfere with beneficial uses assigned to the RBW.

2. Shall be monitored by the discharge to ensure compliance with this rule, and

3. If the Department, pursuant to notice and opportunity for hearing, finds by preponderant evidence that a discharge has caused substantial damage, it may require conversion of such discharge to offstream cooling or approved alternate methods. In making determinations regarding such conversions, the Department may consider:

a. The nature and extent of the existing damage;

b. The projected lifetime of the existing discharge;

c. Any adverse economic and environmental (including non-water quality) impacts which would result from such conversion; and

d. Such other factors as may be appropriate.

(b) Heated water sources proposed for future discharges into RBW controlled by the state shall not increase the water temperature by more than the monthly temperature limits prescribed for the particular type and location of the RBW. New sources shall include all expansions, modifications, alterations, replacements, or repairs which result in an increased output of ten percent (10%) or more of the level of energy production which existed on the date this rule became effective. Water temperatures shall be measured by procedures approved by the Florida Department of Pollution Control (DPC). In all cases where a temperature rise above ambient is allowed and a maximum RBW temperature is also prescribed, the lower of the two limitations shall be the control temperature.

(c) Definitions.

(i) Ambient (natural) temperature of a RBW is the existing temperature of the receiving water at a location which is unaffected by manmade thermal discharges and a location which is also of a depth and exposure to winds and currents which typify the most environmentally stable portions of the RBW.

(ii) Coastal waters shall be all waters in the state which are not classified as fresh waters or as open waters.

(iii) A cooling pond is a body of water enclosed by natural or constructed restraints which has been approved by the Florida DPC for purposes of controlling heat dissipation from thermal discharges.

(iv) An existing heat source is any thermal discharge (a) which is presently taking place, or (b) which is under construction or for which a construction or operating permit has been issued prior to the effective date of this rule.

(v) Fresh waters shall be all waters of the state which are contained in lakes and ponds, or are in flowing streams above the zone in which tidal actions influence the salinity of the water and where the concentration of chloride ions is normally less than 1500 mg/l.

(vi) Open waters shall be waters in the state extending seaward from the most seaward 18-foot depth contour line (three-fathom bottom depth contour) which is offshore from any island; exposed or submerged bar or reef; or mouth of any embayment or estuary which is narrowed by headlands. Contour lines shall be determined from Coast and Geodetic Survey Charts.

(vii) The point of discharge (POD) for a heated water dicharge shall be primarily that point at which the effluent physically leaves its carrying conduit (open or closed), and discharges into the waters of the state, or, in the event it is not practicable to measure temperature at the end of the discharge conduit, a specific point designated by the Florida Department of Pollution Control for that particular thermal discharge.

(viii) Heated water discharges are the effluents from commercial or industrial activities or processes in which water is used for the purpose of transporting waste heat, and which constitute heat sources of one million British

Thermal Units per hour (1,000,000 BTU/HR.), or greater.

(ix) Blowdown shall mean the minimum discharge of recirculating cooling water for the purpose of discharging materials contained in the water, the further buildup of which would cause concentrations in amounts exceeding limits established by best engineering practice.

(x) Recirculating cooling water shall mean water which is used for the purpose of removing waste heat and then passed through a cooling system for the purpose of removing such heat from the water and then, except for blowdown, is used again to remove waste heat.

(d) Monthly and Maximum Temperature Limits

(i) Fresh Waters — Heated water with a temperature at the POD more than 5 degrees F higher than the ambient (natural) temperature of any stream shall not be discharged into such stream. At all times under all conditions of stream flow the discharge temperature shall be controlled so that at least two-thirds (2/3) of the width of the stream's surface remains at ambient (natural) temperature. Further, no more than one-fourth (1/4) of the cross-section of the stream at a traverse perpendicular to the flow shall be heated by the discharge. Heated water with a temperature at the POD more than 3 degrees F higher than the ambient (natural) temperature of any lake or reservior shall not be discharged into such lake or reservoir. Further, no heated water with a temperature above 90 degrees F shall be discharged into any fresh waters in Northern Florida regardless of the ambient temperature of the RBW. In Peninsular Florida, heated waters above 92 degrees F shall not be discharged into fresh waters.

(ii) Coastal Waters — Heated water with a temperature at the POD more than 2 degrees F higher than the ambient (natural) temperature of the RBW shall not be discharged into coastal waters in any zone during the months of June, July, August, and September. During the remainder of the year, heated water with a temperature at the POD more than 4 degrees F higher than the ambient (natural) temperature of the RBW shall not be discharged into coastal waters in any zone. In addition, during June, July, August, and September, no heated water with a temperature above 92 degrees F shall be discharged into coastal waters. Further, no heated water with a temperature above 90 degrees F shall be discharged into coastal waters during the period October thru May.

(iii) Open Waters — Heated water with a temperature at the POD up to 17 degrees F above ambient (natural) temperature of the RBW may be discharged from an open or closed conduit into open waters under the following restraints: The surface temperature of the RBW shall not be raised to more than 97 degrees F and the POD must be sufficient distance offshore to ensure that the adjacent coastal waters are not heated beyond the temperatures permitted in such waters.

(iv) Cooling Ponds — The temperature for heated water discharged from a cooling pond shall be measured at the POD from the pond, and the temperature limitation shall be that specified for the RBW.

(e) General.

(i) Daily seasonal temperature variations that were normal to the RBW before the addition of heat from other than natural causes shall be maintained.

(ii) Recapitulation of temperature limitations prescribed above:

ZONE	STREAMS	LAKES	COASTAL		OPEN
			SUMMER	REMAINDER	
NORTH.	90°F Max. AM. +5°F	90°F Max. AM. +3°F	92°F Max. AM. +2°F	90°F Max. AM. +4°F	97°F Max. AM. +17°F
PENIN.	92°F Max. AM. +5°F	92°F Max. AM. +3°F	92°F Max. AM. +2°F	90°F Max. AM. +4°F	97°F Max. AM. +17°F

(f) Upon application on a case by case basis, the Department may establish a zone of mixing beyond the POD to afford a reasonable opportunity for dilution and mixture of heated water discharges with the RBW, in the following manner:

(i) Zones of mixing for thermal discharges from non-recirculated cooling water systems and process water systems of new sources shall be allowed if supported by a demonstration, as provided in section 316(a), Public Law 92-500 and regulations promulgated thereunder, including 40 C.F.R. Part 122, by an applicant that the proposed mixing zone will assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made and such demonstration has not been rebutted. It is the intent of the board that to the extent practicable, proceedings under this provision should be conducted jointly with proceedings before the federal government under section 316(a), Public Law 92-500.

(ii) Zones of mixing for blowdown discharges from recirculated cooling water systems, and for discharges from non-recirculated cooling water systems of existing sources, shall be established on the basis of the physical and biological characteristics of the RBW.

(iii) When a zone of mixing is established pursuant to this subsection 17-3.05(1)(f), Florida Administrative Code, any otherwise applicable temperature limitations contained in section 17-3.05(1), Florida Administrative Code, shall be met at its boundary; however, the Department may also establish maximum numerical temperature limits to be measured at the POD and to be used in lieu of the general temperature limits in section 17-3.05(1), Florida Administrative Code, to determine compliance by the discharge with the established mixing zone and the temperature limits in section 17-3.05(1), Florida Administrative Code.

17-3.051 MINIMUM CRITERIA FOR SURFACE WATERS

All surface waters of the State shall at all places and at all times be free from:

(1) Domestic, industrial, agricultural, or other man-induced non-thermal components of discharges which, alone or in combination with other substances or in combination with other components of discharges (whether thermal or non-thermal);

(a) Settle to form putrescent deposits or otherwise create a nuisance; or

(b) Float as debris, scum, oil, or other matter in such amounts as to form nuisances; or

(c) Produce color, odor, taste, turbidity, or other conditions in such degree as to create a nuisance; or

(d) Are acutely toxic; or

(e) Are present in concentrations which are carcinogenic, mutagenic, or teratogenic to human beings or to significant, locally occurring, wildlife or aquatic species; or

(f) Pose a serious danger to the public health, safety, or welfare.

(2) Thermal components of discharges which, alone, or in combination with other discharges or components of discharges (whether thermal or non-thermal);

(a) Produce conditions so as to create a nuisance; or

(b) Do not comply with applicable provisions of Subsection 17-3.05(1), F.A.C.

17-3.061 SURFACE WATERS: GENERAL CRITERIA

(1) The criteria of surface water quality hereinafter provided shall be applied to all surface waters except within zones of mixing.

(2) A violation of any of the following surface water quality criteria constitutes pollution. Additional, more stringent or alternative criteria than indicated in this paragraph may, however, be specified for individual classes of water under Sections 17-3.091, 17-3.111, 17-3.121, 17-3.131, and 17-3.141 of this Chapter.

(a) Arsenic — shall not exceed 0.05 milligrams per liter (mg/l).

(b) BOD — shall not be increased to exceed values which would cause dissolved oxygen to be depressed below the limit established for each class and, in no case shall it be great enough to produce nuisance conditions.

(c) Chlorides — in predominantly marine waters, the chloride content shall not be increased more than ten percent (10%) above normal background chloride content. Normal daily and seasonal fluctuations in chloride levels shall be maintained.

(d) Chromium — shall not exceed 0.50 milligrams (mg)/l hexavalent or 1.0 milligrams (mg)/l total chromium in effluent discharge and shall not exceed 0.05 milligrams (mg)/l total chromium after reasonable mixing in the receiving water.

(e) Copper — shall not exceed 0.5 milligrams (mg)/l.

(f) Detergents — shall not exceed 0.5 milligrams (mg)/l.

(g) Dissolved Oxygen —

1. Notwithstanding the specific numerical criteria applicable to individual classes of water, dissolved oxygen levels that are attributable to natural background conditions or man-induced conditions which cannot be controlled or abated may be established as alternative dissolved oxygen criteria for a water body or portion of a water body.

2. Alternative dissolved oxygen criteria may be established by the Secretary or a District Manager in conjunction with the issuance of a permit or other Department action only after public notice and opportunity for public hearing. The determination of alternative criteria shall be based on consideration of the factors described in Section 17-3.031(2)(a)-(d), F.A.C.

3. Alternative criteria shall not result in a lowering of dissolved oxygen levels in the water body, water body segment or any adjacent waters, and shall not violate the minimum criteria specified in Section 17-3.051, F.A.C. Daily and seasonal fluctuations in dissolved oxygen levels shall be maintained.

(h) Fluorides — shall not exceed 10.0 milligrans (mg)/l as fluoride ion.

(i) Lead — shall not exceed 0.05 milligrams (mg)/l.

(j) Nutrients — The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this Chapter. Man-induced nutrient enrichment (total nitrogen or total phosphorus) shall be considered degradation in relation to the provisions of Section 3.041 of this Chapter and Section 17-4.242.

(k) Oils and Greases:

1. Dissolved or emulsified oils and greases shall not exceed 5.0 milligrams (mg)/l.

2. No undissolved oil, or visible oil defined as iridescence, shall be present to cause taste or odor, or otherwise interfere with the beneficial uses of waters.

(l) pH — shall not vary more than one unit above or below natural background provided that the pH is not lowered to less than 6 units or raised above 8.5 units. If natural background is less than 6 units, the pH shall not vary below natural background or vary more than one unit above natural background. If natural background is higher than 8.5 units, the pH shall not vary above natural background or vary more than one unit below background.

(m) Phenolic compounds as listed — Chlorinated phenols including trichlorophenols; chlorinated creosols; 2-chlorophenol; 2, 4 - dichlorophenol and pentachlorophenol; 2, 4 - dinitrophenol; phenol — shall not exceed 1.0 micrograms per litre (ug/l) unless higher values are shown not to be chronically toxic. Such higher values shall be approved in writing by the Secretary. Phenolic compounds other than those produced by the natural decay of plant material, named or unnamed, shall not taint the flesh of edible fish or shellfish or produce objectionable taste or odor in a drinking water supply.

(n) Radioactive Substances:

1. Combined radium 226 and 228 — shall not exceed five picocuries per liter.

2. Gross alpha particle activity including radium 226, but excluding radon and uranium — shall not exceed fifteen picocuries per liter.

(o) Specific Conductance — shall not be increased more than 100% above background levels or to a maximum level of 500 micromhos per centimeter in surface waters in which the specific conductance of the water at the surface is less than 500 micromhos per centimeter; and shall not be increased more than 50% above background level or to a maximum level of 5,000 micromhos per centimeter in surface waters in which the specific conductance of the water at the surface is equal to or greater than 500 micromhos per centimeter but less than 5,000 micromhos per centimeter.

(p) Substances in concentrations which injure, are chronically toxic to, or produce adverse physiological or behavioral response in humans, animals, or plants — none shall be present.

(q) Substances in concentrations which result in the dominance of nuisance species — none shall be present.

(r) Turbidity — shall not exceed 29 Nephelometric Turbidity Units (NTU's) above natural background.

17-3.081 CLASSIFICATION OF SURFACE WATERS, USAGE, RECLASSIFICATION

(1) All surface waters of the State have been classified according to designated uses as follows:

CLASS I — Potable Water Supplies
CLASS II — Shellfish Propagation or Harvesting
CLASS III — Recreation, Propagation and Maintenance of a Healthy Well-balanced Population
CLASS IV — Agricultural Water Supplies
CLASS V — Navigation, Utility and Industrial Use

(2) Classification of a water body according to a particular designated use or uses does not preclude use of the water for other purposes.

(3) The specific water quality criteria corresponding to each surface water classification are listed in Sections 17-3.091 to 17-3.151, inclusive.

(4) Water quality classifications are arranged in order of the degree of protection required, with Class I water having generally the most stringent water quality criteria and Class V the least. However, Class I, II, and III surface waters share water quality criteria established to protect recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife.

(5) Criteria applicable to a classification are designed to maintain the minimum conditions necessary to assure the suitability of water for the designated use of the classification. In addition, applicable criteria are generally adequate to maintain minimum conditions required for the designated uses of less stringently regulated classifications. Therefore, unless clearly inconsistent with the criteria applicable, the designated uses of less stringently regulated classifications shall be deemed to be included within the designated uses of more stringently regulated classifications.

(6) Any person regulated by the Department or having a substantial interest in this Chapter may seek reclassification of waters of the State by filing a petition with the Secretary in the form required by Section 17-1.24, F.A.C.

(7) A petition for reclassification shall reference and be accompanied by the information necessary to support the affirmative finding required in this section to support the proposed reclassification.

(8) All reclassifications of waters of the State shall be adopted, after public notice and public hearing, only upon an affirmative finding by the Environmental Regulation Commission that:

(a) The proposed reclassification will establish the present and future most beneficial use of the waters; and

(b) Such a reclassification is clearly in the public interest.

(9) Reclassification of waters of the State which establishes more stringent criteria than presently established by this Chapter shall be adopted, only upon additional affirmative finding by the Environmental Regulation Commission that the proposed designated use is attainable, upon consideration of environmental, technological, social, economic, and institutional factors.

17-3.091 CRITERIA: CLASS I WATERS — POTABLE WATER SUPPLIES — SURFACE WATERS

The criteria listed below are for surface waters designated for use as a potable supply. The standards contained in Sections 17-3.051 and 17-3.061 shall apply to all waters of this class, unless more stringent levels are specified below. The following criteria are to be applied except within zones of mixing:

(1) Alkalinity — shall not be depressed below 20 milligrams per litre ((mg)/l) as $CaCO_3$.

(2) Ammonia (un-ionized) — shall not exceed 0.02 milligrams (mg)/l.

(3) Bacteriological Quality — Coliform group not to exceed 1,000 per 100 milliliters as a monthly average, using either most probable number (MPN) or membrane filter (MF) counts; nor to exceed 1,000 per 100 milliliters in more than 20% of the samples examined during any month; nor exceed 2,400 per 100 milliliters (MPN or MF count) at any time. Based on a minimum of five samples taken over a 30-day period, the fecal coliform bacterial level shall not exceed 200 per 100 milliliters as computed by the log mean, nor shall more than 10% of the total samples taken during any 30-day period exceed 400 per 100 milliliters.

(4) Barium — shall not exceed 1 milligrams (mg)/l.

(5) Beryllium — shall not exceed 0.11 milligrams (mg)/l in waters with a hardness equal to or less than 150 (in milligrams (mg)/l of $CaCO_3$), and shall not exceed 1.10 milligrams (mg)/l in harder waters.

(6) Biological Integrity — the Shannon-Weaver diversity index of benthic macroinvertebrates shall not be reduced to less than 75% of background levels as measured using organisms retained by a U.S. Standard No. 30 sieve and collected and composited from a minimum of three Hester-Dendy type artificial substrate samplers of 0.10 to 0.15 square meters area, each incubated for a period of four weeks.

(7) Cadmium — shall not exceed 0.8 micrograms per litre (ug)/l) in a water with a hardness (in milligrams (mg)/l of $CaCO_3$) equal to or less than 150, and shall not exceed 1.2 micrograms (ug)/l in harder waters.

(8) Chlorides — shall not exceed two hundred fifty (250) milligrams (mg)/l.

(9) Chlorine (total residual) — shall not exceed 0.01 milligrams (mg)/l.

(10) Copper — shall not exceed 30 micrograms (ug)/l.

(11) Cyanide — shall not exceed 5.0 micrograms (ug)/l.

(12) Dissolved Oxygen — shall not be less than 5 milligrams (mg)/l. Normal daily and seasonal fluctations above this level shall be maintained.

(13) Dissolved Solids — not to exceed five hundred (500) milligrams (mg)/l as a monthly average or exceed one thousand (1,000) milligrams (mg)/l at any time.

(14) Fluorides — shall not exceed 1.5 milligrams (mg)/l.

(15) Iron — shall not exceed 0.3 milligrams (mg)/l.

(16) Lead — shall not exceed .03 milligrams (mg)/l.

(17) Mercury — shall not exceed 0.2 micrograms (ug)/l.

(18) Nickel — shall not exceed 0.1 milligrams (mg)/l.

(19) Nitrate — shall not exceed 10 milligrams (mg)/l as N or that concentration determined in (21) below.

(20) Nutrients — In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora and fauna.

(21) Pesticides and Herbicides.

(a) Aldrin plus Dieldrin — shall not exceed 0.003 micrograms (ug/l.

(b) Chlordane — shall not exceed 0.01 micrograms (ug)/l.

(c) 2-4-D — shall not exceed 100 micrograms (ug)/l.

(d) 2,4,5-TP — shall not exceed 10 micrograms (ug)/l.

(e) DDT — shall not exceed 0.001 micrograms (ug)/l.

(f) Demeton — shall not exceed 0.1 micrograms (ug)/l.

(g) Endosulfan — shall not exceed 0.003 micrograms (ug)/l.

(h) Endrin — shall not exceed 0.004 micrograms (ug)/l.

(i) Guthion — shall not exceed 0.01 micrograms (ug)/l.

(j) Heptachlor — shall not exceed 0.001 micrograms (ug)/l.

(k) Lindane — shall not exceed 0.01 micrograms (ug)/l.

(l) Malathion — shall not exceed 0.1 micrograms (ug)/l.

(m) Methoxychlor — shall not exceed 0.03 micrograms (ug)/l.

(n) Mirex — shall not exceed 0.001 micrograms (ug)/l.

(o) Parathion — shall not exceed 0.04 micrograms (ug)/l.

(p) Toxaphene — shall not exceed 0.005 micrograms (ug)/l.

(22) Phthalate Esters — shall not exceed 3.0 micrograms (ug)/l.

(23) Polychlorinated Biphenyls — shall not exceed 0.001 micrograms (ug)/l.

(24) Selenium — shall not exceed 0.01 milligrams (mg)/l.

(25) Silver — shall not exceed 0.07 micrograms (ug)/l.

(26) Total Dissolved Gases — shall not exceed 110% of the saturation value for gases at the existing atmospheric and hydrostatic pressure.

(27) Transparency — the depth of the compensation point for photosynthetic activity shall not be reduced by more than 10% as compared to the natural background value.

(28) Zinc — shall not exceed 0.03 milligrams (mg)/l.

17-3.111 CRITERIA: CLASS II WATERS — SHELLFISH PROPAGATION OR HARVESTING — SURFACE WATERS

The criteria listed below are for surface waters classified as Class II. The standards contained in Section 17-3.051 and 17-3.061 also shall apply to all waters of this class, unless additional or more stringent levels are specified below. The following criteria are to be applied except within zones of mixing:

(1) Aluminum — shall not exceed 1.5 milligrams ((mg)/l).

(2) Antimony — shall not exceed 0.2 milligrams (mg)/l.

(3) Bacteriological Quality — the median coliform MPN (Most Probable Number) of water shall not exceed seventy (70) per hundred (100) milliliters, and not more than ten percent (10%) of the samples shall exceed a MPN of two hundred and thirty (230) per one hundred (100) milliliters. The fecal coliform bacterial level shall not exceed a median value of 14 MPN per 100 milliliters with not more than ten percent (10%) of the samples exceeding 43 MPN per 100 milliliters.

(4) Biological Integrity — the Shannon-Weaver diversity index of benthic macroinvertebrates shall not be reduced to less than 75% of established background levels as measured using organisms retained by a U.S. Standard No. 30 sieve and collected and composited from a minimum of three natural substrate samples, taken with Ponar type samplers with minimum sampling areas of 225 square centimeters.

(5) Bromine and Bromates — free (molecular) bromine shall not exceed 0.1 milligrams (mg)/l, and bromates shall not exceed 100 milligrams (mg)/l.

(6) Cadmium — shall not exceed 3.0 micrograms (μg)/l).

(7) Chlorine (total residual) — shall not exceed 0.01 milligrams (mg)/l.

(8) Copper — shall not exceed 0.015 milligrams (mg)/l.

(9) Cyanide — shall not exceed 5.0 micrograms (μg)/l.

(10) Dissolved Oxygen — the concentration in all waters shall not average less than 5 milligrams (mg)/l in a 24-hour period and shall never be less than 4 milligrams (mg)/l. Normal daily and seasonal fluctuations above these levels shall be maintained.

(11) Fluorides — shall not exceed 1.5 milligrams (mg)/l.

(12) Iron — shall not exceed 0.3 milligrams (mg)/l.

(13) Manganese — shall not exceed 0.1 milligrams (mg)/l.

(14) Mercury — shall not exceed 0.1 micrograms (μg)/l.

(15) Nickel — shall not exceed 0.1 milligrams (mg)/l.

(16) Nutrients — In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora and fauna.

(17) Odor — threshold odor number not to exceed 24 at 60 degrees C as a daily average.

(18) Pesticides and Herbicides:

(a) Aldrin plus Dieldrin — shall not exceed 0.003 micrograms (μg)/l.

(b) Chlordane — shall not exceed 0.004 micrograms (μg)/l.

(c) DDT — shall not exceed 0.001 micrograms (μg)/l.

(d) Demeton — shall not exceed 0.1 micrograms (μg)/l.

(e) Endosulfan — shall not exceed 0.001 micrograms (μg)/l.

(f) Endrin — shall not exceed 0.004 micrograms (μg)/l.

(g) Guthion — shall not exceed 0.01 micrograms (μg)/l.

(h) Heptachlor — shall not exceed 0.001 micrograms (μg)/l.

(i) Lindane — shall not exceed 0.004 micrograms (μg)/l.

(j) Malathion shall not exceed 0.1 micrograms (μg)/l.

(k) Methoxychlor — shall not exceed 0.03 micrograms (μg)/l.

(l) Mirex — shall not exceed 0.001 micrograms (μg)/l.

(m) Parathion — shall not exceed 0.04 micrograms (μg)/l.

(n) Toxaphene — shall not exceed 0.005 micrograms (μg)/l.

(19) pH — shall not vary more than one unit above or below natural background of coastal waters as defined in 17-3.05(1)(c), F.A.C., or more than two-tenths unit above or below natural background of open waters as defined in 17-3.05(1)(c), F.A.C., provided that the pH is not lowered to less than 6.5 units or raised above 8.5 units. If natural background is less than 6.5 units, the pH shall not vary below natural background or vary more than one unit above natural background for coastal waters or more than two-tenths unit above natural background for open waters. If natural background is higher than 8.5 units, the pH shall not vary above natural background or vary more than one unit below natural background of coastal waters or more than two-tenths unit below natural background of open waters.

(20) Phosphorus (elemental) — shall not exceed 0.1 micrograms (μg)/l.

(21) Polychlorinated Biphenyls — shall not exceed 0.001 micrograms (μg)/l.

(22) Selenium — shall not exceed 0.025 milligrams (mg)/l.

(23) Silver — shall not exceed 0.05 micrograms (μg)/l.

(24) Total Dissolved Gases — shall not exceed 110% of the saturation value for gases at the existing atmospheric and hydrostatic pressures.

(25) Transparency — the depth of the compensation point for photosynthetic activity shall not be reduced by more than 10% as compared to the natural background value.

17-3.121 CRITERIA: CLASS III WATERS — RECREATION — PROPAGATION AND MANAGEMENT OF FISH AND WILDLIFE — SURFACE WATERS

The criteria listed below are for surface waters classified as Class III. The standards contained in Sections 17-3.051 and 17-3.061 also apply to all waters of this classification, unless additional or more stringent criteria are specified below. The following criteria are to be applied except within zones of mixing.

(1) Alkalinity — shall not be depressed below 20 milligrams per liter ((mg)/l) as $CaCO_3$ in predominantly fresh waters.

(2) Aluminum — shall not exceed 1.5 milligrams (mg)/l in predominantly marine waters.

(3) Ammonia (un-ionized) — shall not exceed 0.02 milligrams (mg)/l in predominantly fresh waters.

(4) Antimony — shall not exceed 0.2 milligrams (mg)/l in predominantly marine waters.

(5) Bacteriological Quality — fecal coliform bacteria shall not exceed a monthly average of 200 per 100 ml of sample, nor exceed 400 per 100 ml of sample in 10 percent of the samples, nor exceed 800 per 100 ml on any one day, nor exceed a total coliform bacteria count of 1,000 per 100 ml as a monthly average, nor exceed 1,000 per 100 ml in more than 20 percent of the samples examined during any month, nor exceed 2,400 per 100 ml at any time. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period. Either MPN or MF counts may be utilized.

(6) Beryllium — in predominantly fresh waters shall not exceed 0.011 milligrams (mg)/l in waters with a hardness equal to or less than 150 (in milligrams (mg)/l of $CaCO_3$) and shall not exceed 1.10 milligrams (mg)/l in harder waters.

(7) Biological Integrity — the Shannon-Weaver diversity index of benthic macroinvertebrates shall not be reduced to less than 75 percent of established background levels as measured using organisms retained by a U.S. Standard No. 30 sieve and, in predominantly fresh waters, collected and composited from a minimum of three Hester-Dendy type artificial substrate samplers of 0.10 to 0.15 m^2 area each incubated for a period of four weeks, and in predominantly marine waters, collected and composited from a minimum of three natural substrate samples, taken with Ponar type samplers with minimum sampling area of 225 square centimeters.

(8) Bromine and Bromates — free (molecular) bromine shall not exceed 0.1 milligrams (mg)/l in predominantly marine waters, and bromates shall not exceed 100 milligrams (mg)/l in predominantly marine waters.

(9) Cadmium — shall not exceed 5.0 micrograms per litre (μg)/l in predominantly marine waters, shall not exceed 0.8 micrograms (μg)/l in predominantly fresh waters in water with a hardness (in milligrams (mg)/l of $CaCO_3$) of less than 150, and shall not exceed 1.2 micrograms (μg)/l in harder waters.

(10) Chlorine (total residual) — shall not exceed 0.01 milligrams (mg)/l.

(11) Copper — shall not exceed .015 milligrams (mg)/l in predominantly marine waters; shall not exceed .03 milligrams (mg)/l in predominantly fresh waters.

(12) Cyanide — shall not exceed 5.0 micrograms (μg)/l.

(13) Dissolved Oxygen — in predominantly fresh waters, the concentration shall not be less than 5 milligrams (mg)/l. In predominantly marine waters, the concentration shall not average less than 5 milligrams (mg)/l in a 24-hour period and never less than 4 milligrams (mg)/l. Normal daily and seasonal fluctuations above these levels shall be maintained in both predominantly fresh waters and predominantly marine waters.

(14) Fluorides — shall not exceed 5.0 milligrams (mg)/l in predominantly marine waters.

(15) Iron — shall not exceed 1.0 milligrams (mg)/l in predominantly fresh waters; 0.3 milligrams (mg)/l in predominantly marine waters.

(16) Lead — shall not exceed .03 milligrams (mg)/l in predominantly fresh waters.

(17) Mercury — shall not exceed 0.1 micrograms (μg)/l in predominantly marine waters; shall not exceed 0.2 micrograms (μg)/l in predominantly fresh waters.

(18) Nickel — shall not exceed 0.1 milligrams (mg)/l.

(19) Nutrients — In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.

(20) Pesticides and Herbicides:

(a) Aldrin plus Dieldrin — shall not exceed 0.003 micrograms (μg)/l.

(b) Chlordane — shall not exceed 0.01 micrograms (μg)/l in predominantly fresh waters and 0.004 micrograms (μg)/l in predominantly marine waters.

(c) DDT — shall not exceed 0.001 micrograms (μg)/l.

(d) Demeton — shall not exceed 0.1 micrograms (μg)/l.

(e) Endosulfan — shall not exceed 0.003 micrograms (μg)/l in predominantly fresh waters and 0.001 micrograms (μg)/l in predominantly marine waters.

(f) Endrin — shall not exceed 0.004 micrograms (μg/l.

(g) Guthion — shall not exceed 0.01 micrograms (μg)/l.

(h) Heptachlor — shall not exceed 0.001 micrograms (μg)/l.

(i) Lindane — shall not exceed 0.01 micrograms (μg)/l in predominantly fresh waters and 0.004 micrograms (μg)/l in predominantly marine waters.

(j) Malathion — shall not exceed 0.1 micrograms (μg)/l.

(k) Methoxychlor — shall not exceed 0.03 micrograms (μg)/l.

(l) Mirex — shall not exceed 0.001 micrograms (μg)/l.

(m) Parathion — shall not exceed 0.04 micrograms (μg)/l.

(n) Toxaphene — shall not exceed 0.005 micrograms (μg)/l.

(21) pH — shall not vary more than one unit above or below natural background of predominantly fresh waters and coastal waters as defined in 17-3.05(1)(c), F.A.C., or more than two-tenths unit above or below natural background of open waters as defined in 17-3.05(1)(c), F.A.C., provided that the pH is not lowered to less than 6 units in predominantly fresh waters, or less than 6.5 units in predominantly marine waters, or raised above 8.5 units. If natural background is less than 6 units, in predominantly fresh waters or 6.5 units in predominantly marine waters, the pH shall not vary below natural background or vary more than one unit above natural background of predominantly fresh waters and coastal waters, or more than two-tenths unit above natural background of open waters. If natural background is higher than 8.5 units, the pH shall not vary above natural background or vary more than one unit below natural background of predominantly fresh waters and coastal waters, or more than two-tenths unit below natural background of open waters.

(22) Phosphorus (elemental) — shall not exceed 0.1 micrograms (μg/l in predominantly marine waters.

(23) Phthalate Esters shall not exceed 3.0 micrograms (μg/l in predominantly fresh waters.

(24) Polychlorinated Biphenyls — shall not exceed 0.001 micrograms (ug)/l.

(25) Selenium — shall not exceed 0.025 milligrams (mg)/l.

(26) Silver — shall not exceed 0.07 micrograms (ug)/l in predominantly fresh waters and 0.05 micrograms (μg)/l in predominantly marine waters.

(27) Total Dissolved Gases — shall not exceed 110% of the saturation value for gases at the existing atmospheric and hydrostatic pressures.

(28) Transparency — the depth of the compensation point for photosynthetic activity shall not be reduced by more than 10 percent compared to the natural background value.

(29) Zinc — shall not exceed .03 milligrams (mg)/l in predominantly fresh waters.

17-3.131 CRITERIA: CLASS IV WATERS — AGRICULTURAL SUPPLIES — SURFACE WATERS

The criteria listed below are for surface waters classified as Class IV. The standards established in Sections 17-3.051 and 17-3.061 also apply to all waters of this classification, unless additional or more stringent criteria are specified below. The following criteria are to be applied except within zones of mixing.

(1) Alkalinity — shall not exceed 600 milligrams (mg)/l as $CaCO_3$.

(2) Beryllium — shall not exceed 0.1 milligrams (mg)/l in waters with a hardness in milligrams (mg)/l of $CaCO_3$ of less than 150 and shall not exceed 0.5 milligrams (mg)/l in harder waters.

(3) Boron — shall not exceed 0.75 milligrams (mg)/l.

(4) Color, odor, and taste producing substances and other deleterious substances, including other chemical compounds, attributable to domestic wastes, industrial wastes, and other wastes — only such amounts as will not render the waters unsuitable for agricultural irrigation, livestock watering, industrial cooling, industrial process water supply purposes or fish survival.

(5) Cyanide — shall not exceed 5.0 micrograms (ug)/l.

(6) Dissolved Oxygen — shall not average less than 4.0 milligrams (mg)/l in a 24-hour period and shall never be depressed below 3.0 milligrams (mg)/l.

(7) Iron — shall not exceed 1.0 milligrams (mg)/l.

(8) Mercury — shall not exceed 0.2 micrograms (ug/l.

(9) Nickel — shall not exceed 0.1 milligrams (mg)/l.

17-3.141 CRITERIA: CLASS V WATERS — NAVIGATION, UTILITY AND INDUSTRIAL USE — SURFACE WATERS.

The criteria listed below are for surface waters classified as Class V. The standards contained in Sections 17-3.051 and 17-3.061 also apply to all waters of this classification unless additional, alternative or more stringent criteria are specified below. The following criteria are to be applied except within zones of mixing:

(1) Cyanide — shall not exceed 5.0 micrograms per litre (ug)/l).

(2) Dissolved Oxygen — not to be depressed below 2.0 milligrams per litre ((mg)/l).

(3) Mercury — shall not exceed 0.2 micrograms (ug)/l.

(4) Odor producing substances — only in such amounts as will not unreasonably interfere with the use of the water for the designated purpose of this classification.

(5) pH — not lower than 5.0 nor greater than 9.5 except certain swamp waters which may be as low as 4.5.

17-3.161 CLASSIFIED WATERS

(1) The surface waters of the State of Florida are classified as Class III — Recreation, Propagation and Management of Fish and Wildlife, except for certain waters which are described in this section. A water body may be designated as an Outstanding Florida Water in addition to being classified as Class I, Class II, or Class III. Outstanding Florida Waters are listed in Section 17-3.041, F.A.C.

(2) Exceptions to Class III:

(a) All secondary and tertiary canals wholly within agricultural areas are classified as Class IV and are not individually listed as exceptions to Class III. "Secondary and tertiary canals" shall mean any wholly artificial canal or ditch which is behind a control structure and which is part of a water control system that is connected to the works (set forth in Section 373.086, F.S.) of a water management district created under Section 373.069, F.S., and that is permitted by such water management district pursuant to Section 373.103, Section 373.413, or Section 373.416, F.S. Agricultural areas shall generally include lands actively used solely for the production of food and fiber which are zoned for agricultural use where county zoning is in effect. Agricultural areas exclude lands which are platted and subdivided or in a transition phase to residential use;

(b) Jumping Gully Creek, Hamilton County, is unclassified; and

(c) The following listed water bodies are classified as Class I-A, Class II, Class IV, or Class V-A:

1. Alachua County — none.
2. Baker County — none.
3. Bay County

Class I-A

Bayou George and Creek — Impoundment to source.

Bear Creek Impoundment to source.

Big Cedar Creek — Impoundment to source.

Deer Point Impoundment — Dam to source.

Econfina Creek — Upstream of Deer Point Impoundment.

Class II

East Bay and Tributaries — East of U.S. Highway 98 to, but excluding, Wetappo Creek.

North Bay and Tributaries — North of U.S. Highway 98 to Deer Point Dam excluding Alligator and Fanning Bayous.

West Bay and Tributaries — West of North Bay (line from West Bay Point on the north to Shell Point on the South) except West Bay Creek (northwest of Channel Marker 27C off Goose Point), Crooked Creek (north of a line from Crooked Creek Point to Doyle Point), and Burnt Mill Creek (north of a line from Graze Point to Cedar Point.

4. Bradford County — none
5. Brevard County

Class I-A

St. Johns River and Tributaries — Lake Washington Dam south through and including Sawgrass Lake, Lake Hellen Blazes, to Indian River County Line.

Class II

Goat Creek

Indian River — Barnes Blvd., south to South Section Line of Section 29, T26S, R37E, Palm Shores.

Indian River — Cape Malabar south to S. Brevard County Line.

Indian River — N. Brevard County Line south to Florida East Coast Railroad Crossing (vicinity Jay Jay).

Kid Creek.

Mosquito Lagoon — North Brevard County Line south to Max Hoeck Creek.

Trout Creek.

6. Broward County

Class I-A

Abandoned Rock Pit — Northeast corner of SR 7 and Prospect Field Road in the S.W. Quarter of Section 7, T49S, R42E.

7. Calhoun County — none.
8. Charlotte County

Class I-A

Alligator Creek — North and south prongs from headwaters to SR 765-A.

Port Charlotte Canal System — Surface waters lying upstream of, or directly connected to, Fordham Waterway upstream of Conway Boulevard.

Prairie Creek — DeSoto County Line to Shell Creek.

Shell Creek Headwaters to Ridge Harbor.

Class II

Bull Bay — mean high water to Charlotte County Line.

Charlotte Harbor — to south Charlotte County Line.

Gasparilla Sound — Placida harbor to Charlotte County Line.

Lemon Bay and Tributaries — N. Charlotte County Line South to Placida Harbor and bounded on the east by SR 775.

Myakka River — N. Charlotte County Line south to Charlotte Harbor.

Placid Harbor — to mean high water.

Turtle Bay — mean high water to Charlotte County Line.

9. Citrus County

Class II

Tidal Creeks and coastal waters — Latitude 28°54'N., south to Hernando County line with the exception of waters which are bounded by and including the Crystal River on the north, St. Martins River on the south, barrier islands on the west, and the mainland on the east.

10. Clay County — none.

11. Collier County

Class II

Cocohatchee River.

Connecting Waterways — Wiggins Pass south to Outer Doctors Bay.

Dollar Bay.

Inner and Outer Clam Bay.

Inner and Outer Doctors Bay.

Little Hickory Bay.

Naples Bay.

Tidal Bays and Passes — Rookery Bay, south and easterly through Ten Thousand Islands to Monroe County Line.

Wiggins Pass.

12. Columbia County — none.

13. Dade County

Class IV

Miami River — Salinity barrier easterly 5.7 miles to Biscayne Bay.

14. DeSoto County

Class I-A

Horse Creek — Vicinity Jct. SR 760 and SR 761 to Peace River.

Prairie Creek — Headwaters to Charlotte County Line.

15. Dixie County

Class II

Coastal Waters — Horseshoe Point south to the basin boundary of USGS Basin 09K as delineated on USGS Map, "Drainage Basins in Florida", Map Series No. 28, October 1967.

Tidal Creeks — north of, but excluding the mouth of, the Suwannee River and south of Horseshoe Point from Suwannee River or Gulf of Mexico to source.

16. Duval County

Class II

Ft. George River — Ft. George Inlet north to Nassau — St. Marys/St. Johns Basin Boundary.

Intracoastal Waterway and tributaries — confluence of Nassau and Amelia Rivers south to Flashing Marker "72", thence eastward along Ft. George River to Ft. George Inlet and includes Garden Creek and both prongs of Simpson Creek.

Nassau River and Creek — Nassau Sound to Seymore Point.

Pumpkinhill Creek

17. Escambia County

Class II

Escambia Bay — Louisville and Nashville Railroad Trestle south to Pensacola Bay (Line from Emanual Point east northeasterly to Garcon Point).

Pensacola Bay — East of a line connecting Emanuel Point on the north to the south end of the Pensacola Bay Bridge (U.S. Highway 98).

Santa Rosa Sound — east of a line connecting Gulf Breeze approach to Pensacola Beach, Bascule Bridge, and Sharp Point with exception of the Navarre Beach area from Channel Marker "109" to Navarre Bridge.

18. Flagler County

Class II

Matanzas River (Intracoastal Waterway) — N.Flagler County Line south to Fl. Marker "109".

Pellicer Creek.

19. Franklin County

Class II

Alligator Harbor — East from a line from Peninsula Point north to St. James Island to mean high water.

Apalachicola Bay — with exception of area emcompassed within 2-mile radius from Apalachicola entrance of John Gorrie Memorial Bridge.

East Bay — with the exception of area encompassed within 2-mile radius from Apalachicola entrance of John Gorrie Memorial Bridge.

Gulf of Mexico — North of a line from Peninsula Point on Alligator Point to the northeastern tip of Dog Island and bounded on the east by Alligatory Harbor and west by St. George Sound.

Ochlockonee Bay — Confluence of sopchoppy of Ochlockonee Rivers to Gulf of Mexico.

St. George Sound — Gulf of Mexico westerly to Apalachicola Bay.

St. Vincent Sound — Apalachicola Bay to Indian Pass.

Tributaries to East Bay — these tributaries within USGS Basin 11D as delineated on USGS Map, "Drainage Basins in Florida", Map Series No. 28, October 1967.

20. Gadsden County

Class I-A

Holman Branch — SR 270-A to source.

Mosquito Creek — U.S. Highway 90 north to Florida State Line.

Quincy Creek — SR 65 to source.
21. Gilchrist County — none.
22. Glades County
Class I-A
Lake Okeechobee
23. Gulf County
Class II
Indian Lagoon — West of Indian Pass and St. Vincent Sound.
St. Joseph Bay — South and west of a line from St. Joseph Point to vicinity Port St. Joe.
24. Hamilton County — none.
25. Hardee County — none.
26. Hendry County
Class I-A
Lake Okeechobee.
27. Hernando County — none.
28. Highlands County — none.
29. Hillsborough County
Class I-A
Cow House Creek — Hillsborough River to source.
Hillsborough River — City of Tampa Water Treatment Plant Dam to Flint Creek.
Class II
Old Tampa Bay — All waters within Hillsborough County bounded on the north by SR 60 (Courtney Campbell Parkway), then south by Interstaste 4 (Howard Franklin Bridges), the west by the county line, and the east by the line of mean high water.

Old Tampa Bay and Mobbly Bay — Beginning at the intersection of the north shore of SR 60 (Courtney Campbell Parkway) and Longitude 82°35'45" west, thence due north to the line of mean high water, thence westward along the line of mean high water, including Rocky and Double Branch Creeks to SR 580 and up the upper Tampa Bay watershed canal to a line connecting the lines of mean high water on the outer sides of the canal banks, to the county line, thence southerly along the county line to SR 60, thence along the north shore of SR 60 to the point of beginning.

Tampa Bay — Beginning at Gadsden Point, thence along a line connecting Gadsden Point and the intersection of Gadsden Point Cut and Cut "A" to a point one-half nautical mile inside said intersection, thence westward along a line one-half nautical mile inside and parallel to Gadsden Point Cut, Cut "G", Cut "J", Cut "J2", and Cut "K", to the line of mean high water, thence along the line of mean high water to the point of beginning.

Tampa Bay — Beginning at the intersection of the Hillsborough County Line and the line of mean high water, thence to the rear range marker of Cut "D", thence northerly along the line of Cut "D" range to the point one-half nautical mile inside the southern boundary of Cut "C", thence along a line one-half mile inside and parallel to Cut "C", Cut "D", and Cut "E" to a point with Latitude 27°45'40" north and Longitude 82°30'40" west, thence to a point Latitude 27°47' north and Longitude 82°27' west, thence on a true bearing of 140° to the line of mean high water, thence along the line of mean high water to the western tip of Mangrove Point, thence to the northwestern tip of Tropical Island, thence eastward along the line of mean high water to the eastern tip of Goat Island, thence due south to the line of mean high water, thence along the line of mean high water to the point of beginning.

Tampa Bay — Hillsborough County portion west of the Sunshine Skyway and from the three fathom depth contour up to the line of mean high water.
30. Holmes County — none
31. Indian River County
Class I-A
St Johns River and Tributaries — Brevard County Line south through and including Blue Cypress Lake to SR 60.
Class II
Indian River — Sebastian Inlet (N. Indian River County Line) south to Wabasso vicinity east of channel centerline.
Indian River — Wabasso vicinity south to vicinity North Relief Canal.
32. Jackson County
Class I-A
Econfina Creek — Bay County Line to source.
33. Jefferson County
Class II
Coastal waters — Mouth of Aucilla River west to Wakulla County Line excluding mouths of drainage areas.
34. Lafayette County — none.
35. Lake County — none.
36. Lee County
Class I-A
Caloosahatchee River — E.Lee County Line to South Florida Water Management District Structure 79.
Class II
Charlotte Harbor.
Hell Peckish Bay.
Matanzas Pass — San Carlos Bay to Estero Bay.
Matlacha Pass — Charlotte Harbor to Sun Carlos Bay.
Pine Island Sound — Charlotte Harbor to San Carlos Bay.
San Carlos Bay.
37. Leon County — none.
38. Levy County
Class II
Tidal Creeks within USGS Sub-basin 09J5 south of, but excluding the mouth of, the Suwannee River from Suwannee River or Gulf of Mexico to source.

Tidal Creeks and coastal waters — South from USGS Basin boundary line 09H separating the Suwannee Basin from the Withlacoochee Basin to the Withlacoochee River excluding the Cedar Key area and the mouth of the Withlacoochee River.
39. Liberty County — none.
40. Madison County — none.
41. Manatee County
Class I-A
Manatee River — Rye Bridge Road to the sources thereof, including but not limited to the following tributaries: the East Fork of the Manatee River, the North

Fork of the Manatee River, Boggy Creek, Gilley Creek, Poley Branch, Corbit Branch, Little Deep Branch, Fisher Branch, Ft. Crawford Creek, Webb Branch, Clearwater Branch, Craig Branch, and Guthrey Branch.

Ward Lake — SR 70 to source (SR 675).

Class II

Palma Sola Bay

Passage Key Area — Egmont Key to Anna Maria Island.

Sarasota Bay — East-west line through marker "48" on Intracoastal Waterway south to Manatee County Line.

Terra Ceia Bay — To Terra Ceia Point.

42. Marion County — none

43. Martin County

Class I-A

Lake Okeechobee.

Class II

Great Pocket — St. Lucie River to Peck's Lake.

Indian River — N.Martin County Line south to St. Lucie Inlet, east of Channel centerline.

Loxahatchee River — Above Florida East Coast Railroad Bridge including South, Northwest, and North Forks.

44. Monroe County

Class II

Monroe County Coastline — North Monroe County Line south and including Florida Bay within Everglades National Park.

45. Nassau County

Class II

Alligator Creek.

Nassau River and Creek — Nassau Sount to Seymore Point.

South Amelia River — Nassau River north to Harrison Creek.

46. Okaloosa County

Class II

Choctawatchee Bay and Tributaries — Eastward from a line from White Point southwesterly through Fl. Light Marker "2" of the Intracoastal Waterway to the Walton County Line.

Rocky Bayou — Choctawatchee Bay to Rocky Creek.

Santa Rosa Sound — From a north-south line through Manatee Point west to the Santa Rosa County Line.

47. Okeechobee County

Class I-A

Lake Okeechobee.

48. Orange County — none.

49. Osceola County — none.

50. Palm Beach County

Class I-A

Clear Lake.

Canal C-18 (freshwater portion).

Lake Mangonia.

Lake Okeechobee.

M-Canal L-8 to Lake Mangonia.

Class II

Canal C-18 — Salinity barrier to Loxahatchee River.

Loxahatchee River — Above Florida East Coast railroad Bridge including South, Northwest, and Nork Forks.

51. Pasco County — none.

52. Pinellas County

Class II

Mobbly Bay — Portion in Pinellas County.

Mullet Key Area.

Old Tampa Bay — Gandy Causeway to Safety Harbor.

Safety Harbor to Old Tampa Bay.

Tampa Bay — South Pinellas County Line to Gandy Causeway.

53. Polk County — none.

54. Putnam County — none.

55. St. Johns County

Class II

Guano River and Tributaries — From Guano Lake Dam South to Tolamato River.

Matanzas River, Intracoastal Waterway and Tributaries, excluding Treasure Beach Canal System — From Intracoastal Waterway marker number 29 south to Flagler County Line.

Pellicer Creek.

Salt Run — All waters south of an east-west connecting Lighthouse Park boat ramp with Conch Island.

Tolamato River (North River) and Tributaries — From a line connecting Spanish Landing to Booth Landing south to Intracoastal Waterway marker number 55.

56. St. Lucie County

Class II

Indian River — Middle Cove vicinity south to S.St. Lucie County Line, east of Channel centerline.

Indian River — N.St. Lucie County Line south to Garfield Point.

57. Santa Rosa County

Class II

Blackwater Bay — From a line connecting Robinson's Point to Broad River south to East Bay (line due west from Escribano Point).

East Bay — Blackwater Bay (line due west from Escribano Point) southerly to Pensacola Bay (line from Garcon Point on the North to Redfish Point on the South).

Escambia Bay — Louisville and Nashville Railroad Trestle south to Pensacola Bay (Line from Emanuel Point east northeasterly to Garcon Point).

Pensacola Bay — East of a line connecting Emanuel Point on the north to the south end of the Pensacola Bay Bridge (U.S. Highway 98).

Santa Rosa Sound — From a line connecting Gulf Breeze approach to Pensacola Beach, Bascule Bridge, and Sharp Point east to Santa Rosa/Okaloosa County line with exception of the Navarre Beach area from Channel Marker "109" to Navarre Beach.

Tributaries to East Bay — Those tributaries within USGS Basin 12B as delineated on USGS Map, "Drainage Basins in Florida", Map Series No. 28, October 1967.

58. Sarasota County

Class I-A

Big Slough Canal — South to U.S. 41

Myakka River — Myakka vicinity through Upper and Lower Myakka Lakes to Manhattan Farms.

Class II

Lemon Bay — Forked Creek south to Charlotte County Line.

Myakka River — S.W. North Port Charlotte Limit south to Charlotte County Line.

Sarasota Bay — West of Center (Intracoastal Waterway).

59. Seminole County — none.

60. Sumter County — none.

61. Suwanee County — none.

62. Taylor County

Class V-A

Fenholloway River.

63. Union County — none.

64. Volusia County

Class II

Indian River North — Channel Marker 57 south to Mosquito Lagoon.

Mosquito Lagoon — Indian River North south to S.Volusia County Line.

65. Wakulla County

Class II

Coastal waters — Jefferson County Line west to Live Oak Point excluding mouths of drainage areas.

Oyster Bay, Apalachee Bay, and Tributaries — West of a line from western tip of Shell Point south to FL.4 sec. marker and southerly to Ochlockonee Point, with the exception of Spring Creek and portion of King Bay west and north of a line from westernmost tip of Porter Island south to Hungry Point.

66. Walton County

Class II

Choctawatchee Bay and Tributaries — Eastward from the Okaloosa County Line and south of a line from Alaqua Point to Wheeler Point to the eastern sources.

67. Washington County

Class I-A

Ecofina Creek.